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The Province of Electricity in Railroad Terminal Improvements.

In connection with discussions on the electrification of steam railroads, like that held at the New York Railroad Club last week, it has been customary to lay stress on the cost of making the changes from an electrical standpoint, but very little has been said about the cost of other changes that must be made coincident with the change of motive power. For instance, in making necessary changes and improvements within what has been termed the "Electrical Zone" of the New York Central south of Croton and North White Plains, the cost of electrification is only about one-quarter of the total cost. While it is true that many of these improvements would be necessary with steam as well as with electricity, it remains a fact that the change of motive power requires immediate improvements that otherwise might be postponed for many years. For instance, the use of electricity makes possible more frequent units, so that on a large portion of the territory, at certain hours of the day, trains will run under two-minute headway. This condition renders absolutely necessary the abolition of all grade street crossings and also the elimination of all grade railroad crossings at junctions. These changes in turn require the entire rearrangement and reconstruction of passenger and freight facilities in important cities and villages. Furthermore, with the use of the third rail it has been considered wise to so arrange the new facilities that the public will be barred from trespassing upon the railroad property. Frequent trains will also require more tracks so as to separate, as far as possible, local trains from express trains, with independent tracks for freight service. In some instances this requires the increase in number of main tracks from two to four, and in one instance the number of tracks has been increased from four to eight. The platforms at all stations will also be raised to the level of the car floor so as to facilitate the rapid loading and unloading of cars and minimize the annoyance to passengers in climbing up and down stairways.

From the facts as above outlined it is self-evident that the very large increase in interest charges in connection with the electrification of steam traffic on railroads serving large centers of population bars any opportunity of a reduction in annual cost of operation. Therefore the subject must be approached from the standpoint of an increase in business sufficient to overcome the increase of fixed charges, and it is beyond doubt that this increase of business can be secured in no other way than by the use of electricity.

As to the advisability of making vast expenditures for the improvement of suburban traffic, many railroads have felt that inasmuch as past experience has shown meagre returns for the maintenance of an adequate commuter service, that class of traffic should be discouraged. This, however, would appear to be a wrong principle, for even if no money is to be made from the commuter business, steam railroads, by cherishing and building up this part of their traffic, will make the territory adjacent to their lines attractive so as to bring in a large population, with the idea of securing an increased long-haul passenger and freight business. If this is not done their progressive competitors will be more successful in attracting population, with a resulting serious loss of business in the future. Another evil result of lack of proper development of the suburban service is the constant antagonism between the railroad and its suburban population, which cannot but result in the end in monetary loss to the railroad. Therefore, from every standpoint, it would appear desirable to improve the suburban service of railroads serving large populations.

The ability of electricity to make feasible the increase in capacity of terminals is another important matter to be considered. With steam only the surface area of valuable terminal property can be utilized, whereas with electricity not only may the ground surface be used, but also the underground portions of the property as well as the air rights. As the country grows in population, the lands adjacent to the railroad terminals become more and more valuable, streets are laid out, expensive buildings are constructed, and when an increase in the size of the terminal becomes an absolute necessity, the purchase of adjoining property is out of the question. The only alternative is to go down or up. This can only be done with electricity as a motive power.

In the case of the New York Central terminal improvements in New York, electrification means the reclaiming of about 40 acres of land in the heart of the city. Furthermore, the use of electricity very largely increases the capacity of the terminal, due to the absence of the necessity of switching. With steam service, locomotives must be cut off and stand idle for hours. The passing of the locomotives to and from their engine houses obstructs and clogs the throat of the yard. All of this is avoided by the installation of the electrical multiple unit system, as each car is an independent unit that can move itself equally well in both directions, with no switching service.

In addition to the convenience to passengers of frequent electrical trains, there is of course the added comfort due to the freedom from cinders, gas, smoke and noise, not only through tunnels, but also in the open country during the pleasanter season of the year when the passengers wish to leave the windows open.

To summarize, the use of electricity by steam railroads in the development of territory adjoining great cities appears to be a necessity for the proper development of the future traffic of the companies, particularly in localities like New York.

Train Resistance Formulas.

Among civil engineers there is a subject that is always debatable. No matter how prosy may be a discussion and how sleepy those listening to it, let the proportions and mixing of concrete be mentioned and everybody wakes up. A look of pained surprise passes over the faces of the elders, who settled these matters long ago, at the temerity of the brash young man who dares to suggest improvements on the practice of the past. While one chalks up the blackboard with his pet formulas, another takes up the argument for moderately wet mixtures, and presently everybody is deeply interested. All this is because the subject is one which depends on so many factors that cannot be expressed in any general solution, that it appeals to each engineer differently, according to his experience. Electrical engineers apparently have a similar topic of discussion in train resistance formulas. At a recent meeting of the American Institute of Electrical Engineers, a paper on heavy electric traction was largely devoted to a new formula and a considerable part of the discussion related to it. This is not at all surprising when the important influence of resistance on the proper selection of motors is fully understood. From the printed report of the paper and discussion, which has just appeared, the divergence of views is manifestly as great as ever, but it is not unlikely that the formula of Mr. C. O. Mailloux will gain in prestige as a result of the debate.

While this formula is largely used by electrical engineers in this country and abroad, it is not so well known among civil engineers as it should be. Its author modestly asserts that it is "tentative or provisional," and that it neglects so-called starting friction, which makes it applicable only for trains which have passed the rather low speed at which resistance is a minimum. If this formula is to be classed as provisional, however, what must be said of most of the two hundred or more expressions of this sort that have been propounded? The Mailloux formula is not only developed logically from reasonable assumptions, but it has the unusual merit of agreeing well with experimental results, which is not the case with most of these expressions when applied beyond the limits of the experiments on which they are based. Moreover, the fact that the formula will not give the train resistance at starting and at low speeds is practically of little moment, because the resistance at high speeds is the quantity desired.

As a matter of fact, it is hardly probable that a train resistance formula covering all cases can be devised. It certainly cannot from the data now available. All that can be done at the present time is to employ a formula which agrees with the widest range of reliable test results. The greater the amount of accurate experimental data obtained, the more serviceable will be the formula based on them. The Mailloux formula, like the Kutter formula for the flow of water, is valuable because it contains constants which can be selected to conform with the conditions of each problem to which it is applied. It allows for the diameter of the car wheels and journals and the condition of the track, as well as the number and weight of the cars. While the Smith, Davis, Aspinall, Dennis and some other formulas are certainly good, and reflect credit on the engineers who devised them, The Engineering Record has seen no reason to change its opinion that the Mailloux equation is the most satisfactory yet advanced. Like the Kutter formula, its generality makes it necessary to use great care in the selection of its constants, while its complex form may deter some engineers from using it, who are not familiar with expeditious methods of applying such expressions.

The Cost of Power.

One of the most generally interesting papers on power station management that has appeared recently was presented before the last convention of the Indiana Electric Railway Association by Mr. A. S. Richey. It gives among other data the cost of power at most of the electric railway plants in the State. It is surprising to those acquainted with the secrecy maintained by many companies to observe that the figures cover 85 per cent. of the total capacity of all the stations in Indiana, a fact which is partly explained by the preponderating importance of the stations of two companies, the Indiana Union Traction Co. and the Indianapolis Traction & Terminal Co., which together generate two-thirds of the current employed by electric cars in the State. Their stations are large and economical and the total cost of power for all the roads is consequently brought down to 0.755 cent per kilowatt-hour. This average cost is subdivided as follows: Fuel, 0.526 cent; labor, 0.158 cent; lubricants, waste and miscellaneous supplies, 0.032 cent; repairs, 0.039 cent.

These figures give the average of the returns from thirteen stations. The lowest total cost per kilowatt-hour was 0.505 cent and the highest 2.024 cents. The cost of fuel per kilowatt-hour ranged from 0.368 to 1.405 cents; eight-tenths of the coal is Indiana run of mine and slack. The labor charges per kilowatt-hour range from 0.1 to 0.331 cent; the charges for lubricants and minor supplies from 0.015 to 0.086; the cost of repairs from 0.01 to 0.218. Leaving out of account the figures of the two large companies, the remaining one-third of the total output of current in the State cost 1.021 cents per kilowatt-hour. These figures all give the cost of power at the station switchboard.

Data of this character are most encouraging, and show that the high power charges on some of the roads are probably to be sought outside the station. In fact, Mr. Richey states that on some lines using alternating current distribution and rotary converters, the saving of expense at the station is more than overcome by the inefficiency of transformation due to the use of apparatus working far below its rated capacity. The statistics show that the stations as a rule are managed with a keen eye toward economy and under competent supervision, which emphasizes the truth of an assertion often made in these columns to the effect that in relatively small companies it is more desirable than in the large companies to have as superintendent or manager a thoroughly good technical man.

In small companies it is impossible to have at the head of each department an expert of the first grade, because such men can find more lucrative employment with other interests. Consequently the general manager of a small company must not only be a good executive but must also be a good technical man, able to detect every opportunity for added economy and fully alive to the directions in which money must be spent in order to keep up the property and increase its business. The last place in the whole organization of a small public service corporation in which it is desirable to cut down expense is in the salary of the manager. The good showing made by these Indiana stations is doubtless due to the fact that the men who are in responsible charge of them have a good technical education, for otherwise it is hardly possible that such a high average economy would be attained.

These considerations suggest the further thought that a most promising field for graduates of technical schools is offered by the small public-service corporations of the country. The training of these engineering colleges is rarely sufficiently thorough respecting the importance of economy in the use of time and money in all fields of human endeavor, and if there is any one place where this lesson is taught it is in the service of a little company struggling manfully to keep its head above the financial deep waters which threaten to engulf it. The young man who can win his way to success in such a company will rise to prominence in a wider field. Economy in the management of power plants is just now a prominent topic among the officers of lighting and railway companies, and the technical graduate ought to give a good account of himself in this field. Power plant operation is, in fact, a subject which is still in its swaddling clothes, and while large users of power generally pay close attention to it, it is a matter of every-day knowledge that the boiler room of the average manufacturing establishment is the most wasteful part of the works.

Reform in Technical Analysis.

The analyst is a very necessary evil in engineering work. Chemistry and bacteriology have reached such a position that their assistance is essential for the highest success in many lines, but these sciences are so comprehensive that the more an engineer becomes acquainted with them, the more ready he is to turn all questions concerning them over to those making a specialty of them. Unfortunately the present lack of uniformity in many methods of the analyst throws a wholly unnecessary cloud over such work, and the engineer or superintendent is likely to be misled into forming a low estimate of the value of chemistry by the discrepancies in analyses of the same substance at different laboratories.

One of the first steps taken to remedy these discrepancies by introducing uniform methods of analysis was due to the American Public Health Association. So many methods of testing water and sewage were in vogue a few years ago that the results lost much of their value on account of the difficulty of comparing them. This condition was particularly troublesome to the health officers and engineers of the Association interested in the analytical results but not caring at all about the methods of obtaining them. Accordingly the Association appointed a special committee to investigate the subject and after several years of hard work it submitted its final report at the Havana convention this month. This report will doubtless become the standard manual of water and sewage analysis in this country.

A little later Mr. Clifford Richardson called the attention of the New York Section of the Society of Chemical Industry to the lamentable lack of agreement among different chemists in analyzing Portland cement. About the same time Mr. Thorn Smith made a similar investigation of the discrepancies in methods of analysis of copper slags, and later a similar condition regarding zinc ore analysis was brought to light. As a result of this proof of a wretched lack of harmony in several important lines the American Chemical Society appointed a general committee to make suggestions for reforming the existing conditions. This committee consists of Messrs. W. F. Hillebrand, Chas. B. Dudley, H. N. Stokes and Clifford Richardson, and is now working along the lines of the following policy:

First.—To use every endeavor to impress upon chemists the necessity for such changes, either in methods of analysis or of manipulation, together with a control of the purity of reagents in use, as will make it possible to arrive at greater uniformity in the results of analyses made by different analysts.

Second.—To determine whether the lack of uniformity is to be attributed to lack of proper instruction in our schools or to mere carelessness in manipulation, by inviting the co-operation of the instructors in analytical chemistry in the work, distributing among them standard material for analysis, the results of the analysis of which shall demonstrate the accuracy of the methods taught by them.

Third.—To test, in conjunction with the National Bureau of Standards, various methods, and determine their accuracy and suitability.

Fourth.—To prepare samples of materials of different character whose exact composition shall have been determined by the most careful analyses of experts.

Fifth.—To place such samples in the care of the National Bureau of Standards for preservation and distribution to persons desiring to test their methods of analysis or of manipulation, or to check the work of students or technical chemists employed in works.

Sixth.—To invite the co-operation of persons interested in the analysis of any particular class of material, by the organization of subcommittees for the preparation and distribution of samples, the chairman of which shall be, for the time being, a member of the general committee and entitled to vote on the subject which his subcommittee is considering.

This programme is one of so much direct utility to engineers that it deserves their support. Uniformity in methods of analysis will do away with many seeming variations in the materials of construction which have sorely puzzled engineers in the past. For the work to be really standard it must be done in harmony with the Bureau of Standards of the Department of Commerce and Labor. This is only possible in case Congress will make a small appropriation for the purpose, which will be requested in due course. The appropriation will not be large, while its results will be beneficial to every manufacturer and engineer who has to employ analysts. For this reason The Engineering Record has no hesitation in advising its readers to lend their assistance in securing the necessary grant from Congress.

Notes and Comments.

The Collapse of a Building in Pittsfield, Mass., on Jan. 21, draws attention to the dangerous condition of many structures in small cities and towns. This particular building was erected about fifty years ago by a man who apparently was not very careful in his work, for other structures put up by him have fallen. In the latest failure it seems probable a thin partition wall buckled, allowing the two upper floors to drop to the ground below. Fortunately no life was lost, which would not have been the case had the failure occurred a few hours earlier. The second floor was used for a shop where light machine work was carried on, and was quite heavily loaded in places. It is not at all unlikely that the long-continued jar of the machinery gradually weakened the brickwork until its strength was too small to support the load coming on it. The incident is an important one for small cities and towns to take to heart. Such an accident in a large city is of trivial importance, because the magnitude of its business interests causes the failure of one building to seem insignificant in comparison with all the work that is going on. In a smaller place, however, the relative importance of such an accident is greater, and for this reason it is in the small cities that building ordinances should be most strict and should be enforced most rigorously. The welfare of the entire community demands good regulations and watchfulness on the part of the city authorities responsible for detecting evasions of them.

The Term "Reinforced Concrete" has received the approval of the American Society of Civil Engineers for a combination of concrete strengthened by strips of steel to resist tensile and shearing stresses. The Society's committee on "concrete and concrete-steel" requested at the recent annual meeting a change in its name to "concrete and reinforced concrete," which was unanimously made. There has been so much debate over the proper term for this combination, that it is idle to expect the Society's action will lead to the exclusive use of the name it has adopted, although it will have much influence toward that desirable end. It is safe to say that there is no feature of civil engineering more in dispute at present than the details of reinforced concrete, and now that the name has been adopted by the court of final jurisdiction, it is to be hoped that substantial progress may be made in the important technical features which are still uncertain. The joint research committee of the several engineering societies, which has now been in existence about a year, has laid out such an ambitious program that only executive ability of a high order can carry it through expeditiously. Fortunately it has been possible to secure the co-operation of a number of technical colleges and the facilities for conducting tests in their laboratories are particularly good. It would seem, indeed, that the work will rival in importance the famous arch researches of the Austrian Society of Engineers and Architects.

The Discussion of Mortar Sand printed elsewhere in this issue points out one of the features of civil engineering that make it so attractive to those having a predilection toward research. For many years it was considered that the important advances in engineering work would come mainly through the application of scientific laws to directly useful purposes. The mathematical side of the profession received most attention, and there was a steady tendency toward the introduction of standards for all classes of structures coming under the rule of the civil engineer. Of late it has been learned that standardizing, while a good thing, can be carried too far, and attention is now paid toward the desirability of possible deviations from a standard. This is true of materials as well as of methods of design, and so far as materials are concerned the opportunities for investigation that are afforded are very broad. It might be thought, for example, that the selection of sand for mortar is a matter which involves little skill, yet the paper mentioned shows that one of the greatest railway companies of the country has learned by actual experience that this is not the case. This company has found that a careful examination of the various deposits of sand along its line is well repaid financially. Whether all the conclusions of the author of the paper will be accepted by engineers is open to some doubt, but the value of his work in showing the utility of careful study of such a simple material as sand deserves special mention. It is a fact that much of the best work in engineering during the next few years will be done by investigations like those mentioned, and that the study of the apparently elementary materials of construction still offers a field for a harvest of valuable data.

The Sudden Death on Wednesday of E. H. Mullin deprives the engineering profession of one of its most useful friends. His absence will be felt particularly by the editors of reputable technical journals, who have recognized behind his keen but kindly criticisms of their work the knowledge that comes only from a successful journalistic career and a wide and deep learning of a truly scholarly character. Probably no man ever had a training better fitting him for an unprejudiced critic of technical editorial work. He took his degree at Queen's College, Belfast, with physics for his major subject, but his studies even then covered a broad field. After coming to the United States he joined the famous group of newspaper men whom the late Charles A. Dana gathered about him. There was never such a school for editors before or since as that in the "Sun" offices at that time, and the mere fact that a newspaper man had succeeded under Mr. Dana established his standing in the fourth estate. Mr. Mullin was one of the most successful of the "Sun" staff. He was perfectly independent in his views, doing good work when he could feel in harmony with his chief's opinions and frankly stating his inability to argue well for what seemed to him a bad cause. He thus became a man to be trusted, and was made editor of the "Evening Sun." While he held this position the paper exercised a unique fascination for the educated New Yorker. It told the news of the day with a touch of humor particularly appropriate in an afternoon journal, while its editorial comments were always happy and often marked by a broad sympathy with all the good aspects of life. In this work Mr. Mullin did more to bring the achievements of engineers before the general public than any other newspaper editor. He was in touch with the spirit of engineering progress and the "Evening Sun" under his management was an engineering newspaper. Hence it was not surprising that when President Coffin sought for some one to take charge of the publicity of the General Electric Co., he found Mr. Mullin to be the man for the place. He discharged the often delicate duties of this office with a diplomatic skill that won him the respect of publishers and editors, and his very frank criticisms of their policies have done much to bring technical publications to their present position. The Engineering Record was often benefited by his advice and spurred by his criticism, and his genial presence will be long missed in its offices. Although not a practicing engineer, Mr. Mullin's important position in the field was recognized by his election to the council of the American Institute of Electrical Engineers and to the vice-presidency of the New York Electrical Society, two organizations deeply indebted to him for his untiring work in their interests.

Electricity for Main Line Trains on railways came up incidentally for discussion last week at the meeting of the New York Railroad Club, and it was interesting to observe the very conservative manner in which a number of eminent electrical engineers expressed their views. Mr. Potter, of the General Electric Company, said very little bearing directly on main line operation, and that was chiefly to the effect that electrification is a matter of cost, and its financial benefits must be shown before it should be adopted. Mr. Sprague said that his views could best be given in two axiomatic statements: "Any line, so far as physical handling of traffic and reasonable cost were concerned, could be operated on the working potentials common to-day, provided there was sufficient density of traffic, and on the other hand, no matter to what trolley potential one might go, and no matter how perfect the motor, there were conditions which were prohibitive of electric operation." This dependence of successful operation upon the element of density was one which he had frequently emphasized, and its meaning should be fully realized. It had been suggested that a high load factor was important, which was undoubtedly true, but considered alone it was of little moment, as on straight-away running on a long line a single equipment could give a very high load factor and yet electric equipment be out of all serious consideration. The fact was that a number of units between terminals, with a fair distribution of load as well as a good load factor, ordinarily contributed the elements necessary for really successful commercial operation. Every road presented a special problem, and the wisdom of adopting electricity could only be determined by a most careful analysis of all conditions. Mr. Lamme, of the Westinghouse company, was a strong advocate of alternating current motors for heavy work. His company is now building a 1,500-h.-p. freight locomotive to run on 6,000 volts single-phase with a normal speed of 10 miles per hour. He said that the design of a locomotive for passenger service at a higher speed was an easier problem than the design of a freight locomotive, but none of his remarks was directly applied by him to main line traffic. In fact the only speaker who ventured on direct prophesy on this topic was Mr. B. J. Arnold. He believed that ultimately the steam railroads will all become electrified. He did not claim that electricity was cheaper, and said that not one road in a thousand in the United States could be equipped with the direct current commercially; but there are a great many on which a high-potential alternating-current system could be installed, and the railways eventually will be equipped therewith. He believed that a beginning would be made in a manner somewhat like the following: Some steam road having a sufficient density of traffic between two large cities will be equipped electrically. That road, on account of the liking of the public for electric travel, will get the bulk of the passenger traffic, and consequently the neighboring lines must soon follow. Having their passenger service handled electrically, it will not take long before the freight will be similarly taken care of, especially as fuel becomes dearer.

THE POWER PLANT OF A MODERN RAILROAD TERMINAL.

The Terminal Railroad Association, of St. Louis, Union Station.

By J. R. Bibbins.

To the casual observer the design and equipment of a terminal power station presents problems of no greater difficulty than are ordinarily encountered in the usual power plant. Upon closer examination, however, there is found to be a marked difference: in the one a single definite service is contemplated, one subject to large fluctuations and rapid increase; while in the other, multifarious needs of widely diverse character must be provided for. Furthermore, interruptions of service must be diligently guarded against for they so seriously interfere with the operative functions of the establishment as to render valuable almost any reasonable preventive.

Not long ago an exemplary power plant was placed in operation in St. Louis. It serves the entire terminal properties of the Terminal Railroad Association, which controls transcontinental as well as other traffic centering in St. Louis.

POWER PLANT SERVICE.

Electric Lighting:—Arc and incan., A.C.—1,100 volt primaries.

Arc: { A. C. series.
A. C. multiple.
A. C. multiple 3-wire system.

- Head house.
- Train shed.
- Mail building.
- Five express buildings.
- Coaling station.
- Three engine houses.
- Three switch houses.

Electric Power: { A. C.—1,150 volts main distribution system
D. C.—500 volts elevator and fan motors.
D. C.—50 volts signal systems, train lighting.

- Head House:
  - Three electric elevators, D. C.
  - Ventilating fans for hotel and station.
  - Exhausters for pneumatic tube system.
  - Exhausters for ventilation.
  - Dish-washing machinery.
- Switch and signal system, motor generators.
- Train lighting, battery charging, motor generators.
- Telautograph system, motor generators.
- Mail building, two elevators.
- Express buildings, sixteen elevators.
- Power house, coal crusher.
- Power house, coal elevator and conveyor.
- Sixteenth Street shops.
- Three engine houses.
- Four transfer tables.
- Coaling station.
  - Coal crusher.
  - Coal elevators and conveyor.
  - Ash and cinder elevator.
  - Green sand elevator and conveyor.
  - Dry sand elevator.
  - Car puller.

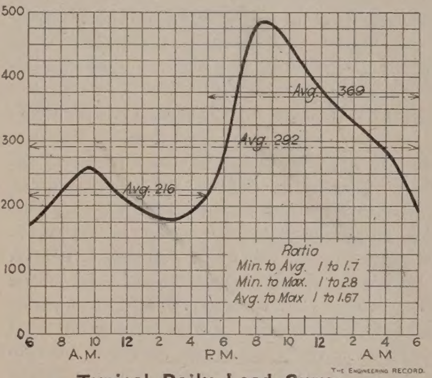
Compressed Air:
- Switch and signal system.
- Car cleaning.
- Air suction—76-tube pneumatic check transfer system.

Steam:
- High pressure for—
  - Power house machinery—150 lbs.
  - Car heating in yards—60 lbs.
  - Steam to kitchen.
  - Occasional building heating.
- Exhaust steam for building heating.

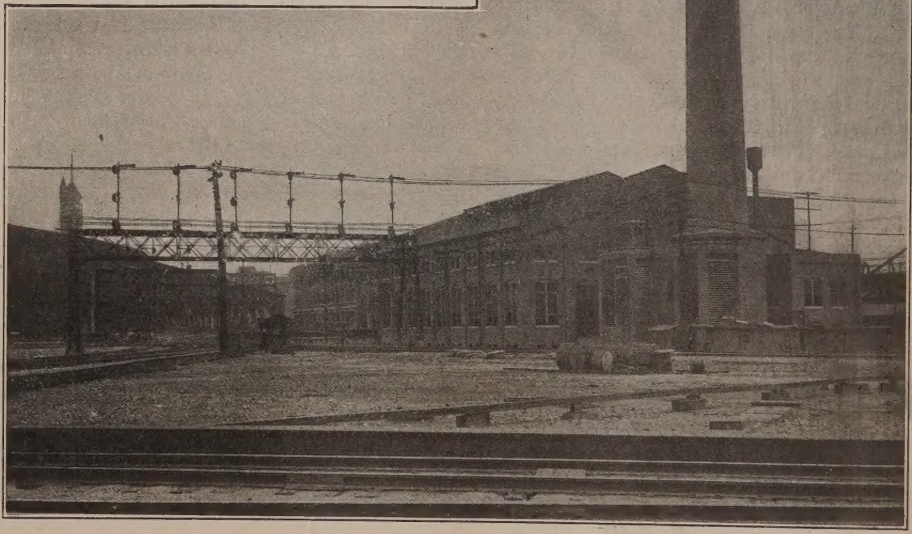
Water:
- General water supply.
- Fire protection system.
- High pressure system for thirty-nine 4,000-lb. baggage elevators.

Only in 1902 was the enlargement of the terminal facilities decided upon, but within the short time preceding the opening of the Exposition the property was largely remodeled. This station ranks among the larger terminals of the world, and in many respects is the largest. The magnitude of the undertaking can only be appreciated by a careful study of the service conditions and the present equipment. These are briefly outlined in the following, although but one branch of this subject, the power station, has been selected for full treatment:

The present terminal property comprises a long head house containing the station proper and executive offices; a hotel fronting on Market St., between Eighteenth and Twentieth; a 32-track five-arch trainshed extending for a distance of 880 ft. to the rear of the head house; a number of express, baggage and mail buildings; signal towers located in the middle of the train yard, controlling the two groups of throat tracks; and a power house situated at one side of the property. A few blocks from this site are located engine houses, transfer tables and a coaling station. The reconstruction work comprised the enlargement of the trainshed; the rearrangement of old and building of new baggage, express and mail buildings; the construction of a new power house; the building of a baggage transfer subway and of main and branch subways connecting the power house with the head house and the several service buildings; the provision of an underground baggage transfer system, handled by hydraulic elevators, thirty-nine in number for which power is supplied entirely from the power house, together with its complementary pneumatic tube system for transferring baggage checks between the head house and baggage subway; also a Gray telautograph system for transmitting and recording train signals.



Typical Daily Load Curve.



The Power Station of the Union Terminal at St. Louis.

Service.—The extreme diversity of service rendered by the power house may be appreciated from the table in the preceding column. It is evident that the operation of the entire terminal property is largely dependent upon that of the power plant, from the heaviest power supply down to the small amount of current required for the signal and telautograph systems, which, however, are of vast importance.

Equipment.—A comprehensive view of the power house equipment is afforded by the accompanying table.

Equipment Data, Union Station Power Plant.

Building.

Size:—	
Length, inside	143 ft. 2 in.
Width, inside	95 ft. 5 in.
Height, to trusses	27 ft. 9 in.
Height, to crane track	22 ft. 7 in.
Basements, height	10 ft. 0 in.
Floor space—sq. ft.	13,660
Engine room, 46.5%	6,345
Boiler room, 52.6%	7,190
Pump room	504
Sq. ft. per e.h.p., eng. room	1.8
Sq. ft. per e.h.p., gen. units	1.35
Sq. ft. per b.h.p., boiler room	2.62

Floors:—Concrete, reinforced with expanded metal, steel framework.
Roof:—Tile, steel trusses.
Walls:—Brick, inside and outside pilasters.
Crane in Eng. Room:—5-ton capacity, 40 ft. span—Northern Engineering Co.
Building constructed by G. A. Fuller Construction Co.

Electrical Equipment.

Generator:—Four 350 kw. revolving field engine type, 2-phase, 1,200 v. 60-cycle, 36 poles, 200 r.p.m., Westinghouse.
Exciters:—Two 62½ kw. eng. type, 125 V., D. C. 275 r.p.m. Westinghouse.
Rotary Converters:—Two 200 kw. 500 to 540 V. Westinghouse induction starting motors.
Switchboard:—32-panel Westinghouse, oil switches, round dial instruments.
Transformers:—56 for all services, including four 50-light arc regulators, Westinghouse.
Cable & Wiring:—Loricated conduit.
Conduit:—McRoy Tile in cement.

Mechanical Equipment.

Engines:—Four 17 & 27x24-in. Westinghouse vert. marine type, rated 500 h.p., 150-lb press., non-condensing; piston valve-h.p.; double-ported, slide valve-l.p.; shaft inertia governor, 200 r.p.m., direct connected.
Exciter Engine:—Two 11x19x11-in. vert. comp. single-acting, 275 r.p.m. Westinghouse.
Air Compressors:—Two 18x32¼x20¼x24-in. duplex two-stage type with intermediate receiver—Ingersoll-Sergeant Co.
Hydraulic Pumps:—Three 12 & 18x5x18-in. compound outside-packed plunger type, Worthington, 120 gal. Mason regulators.
Boilers:—Five batteries = 10 boilers, 275 h.p. Inclined steel header, water tube, Babcock & Wilcox.
Stokers:—10 Roney mechanical, inclined rocking grate.
Flues:—Brick and steel.
Stack:—12 ft. diam., 200 ft. high, Custodis.
Feed Pumps:—Two 14x8½x15-in. duplex outside-packed plunger; Worthington.
Heaters:—Two 2,500 h.p. open type Cochrane.
Coal Bins:—Hoppered bottom, concrete steel, expnd. metal, 500 tons capcy.
Coal Crusher:—Westinghouse, motor driven.
Coal & Ash Elevator:—Vert. swinging bucket type—Link Belt Co., 30 T. per hr.
Coal Conveyor:—Belt type with distributors, Link Belt Co.

Ash Conveyor:—Koppel cars.
Piping:—H. P.; 12-in. header, 6-in. auxiliary, 8-in. to engine.
Drain System:—Holly gravity return.
Exhaust Piping:—16, 18, 20-in. cast iron, covered, 20-in. atmospheric relief with back pressure valve.
Fittings:—Eaton, Cole & Burnham ex. heavy; valves, Chapman.
Pipe Covering:—H.-P., 85% magnesia; exhaust, magnabestos—Keasbey & Mattison Co.
Oil Pumps:—Two 3x2x3-in. duplex, Worthington.
Lubricating System:—Eng. oil, gravity, 15-ft. head; cylinder oil, differential steam pressure.
Filter:—Special design, Westinghouse, Church, Kerr & Co.
Coal:—Illinois slack.

Mechanical Equipment.—If there is one feature of the power equipment which may be termed characteristic it is that of duplication of important functions. This has not been carried to the extent of extreme complication, which has sometimes been mistaken for necessary precaution against stoppages, but rather to a point where the advantages derived have, in the light of past experience, been found to give the greatest insurance against breakdowns with least complication. Thus, the generators, exciters, rotaries, air compressing systems, pumps and heaters are installed in duplicate or multiple. Shut-downs from piping failures are insured against by sectioning. Duplicate feed piping is provided. Further, automatic or semi-automatic systems and labor-saving devices are largely used in order to reduce to the minimum the labor of the plant operators and the cost of operation. Lubrication is thus accomplished by gravity systems; coal is fed to the boiler furnaces by mechanical stokers with gravity fuel feed, and both coal and ashes are handled by power-driven machinery.

Special rather than general requirements of the service largely influenced the selection of machinery; thus, the plant was equipped with non-condensing engines, as no condensing water was available. An ample supply of exhaust steam is thus available for heating and live steam need not be used except during periods of extreme cold. Steam driven auxiliaries are largely used, the exhaust steam being either returned to the feed water heater or in part to the steam heating system.

Electrical Equipment.—Owing to the necessity of variable speed motor drives in the electric elevators, a D. C. supply was preferable. But the main distribution system for lighting and general power covers so large an area that polyphase alternating current was adopted for the main current supply of the station. This arrangement enables induction motors to be generally used, A. C. enclosed arcs for lighting the trainshed and other large areas, and high tension A. C. distribution through the medium of step-down transformers at various load centers. In this manner the lowest possible distribution loss for the system as a whole is secured. The D. C. supply is furnished through the medium of rotary converters controlled from the main switchboard, while the A. C. load is handled by individual feeders directly at generator potential, 1,100 volts. In spite of the diversified service, the composite electrical load upon the plant resembles very closely that of the usual central station, with the exception of a higher all-day average in comparison with the peaks. This is shown by the load curve for July 5, 1904.

Compressed Air Service.—An idea of the importance of this service may be gained by the following facts relating to the signal system: For controlling the various switch movements 503 air cylinders are required, each taking from 0.06 to 1.5 cu. ft. of free air per stroke. Each train entering the station occasions from three to thirty or more switch movements, averaging fifteen. During July the train movements averaged 496 trains per day, totaling 2,193 cars. During the rush hours, however, a maximum of 158 trains per hour was observed, which is equivalent to one every 23 seconds.

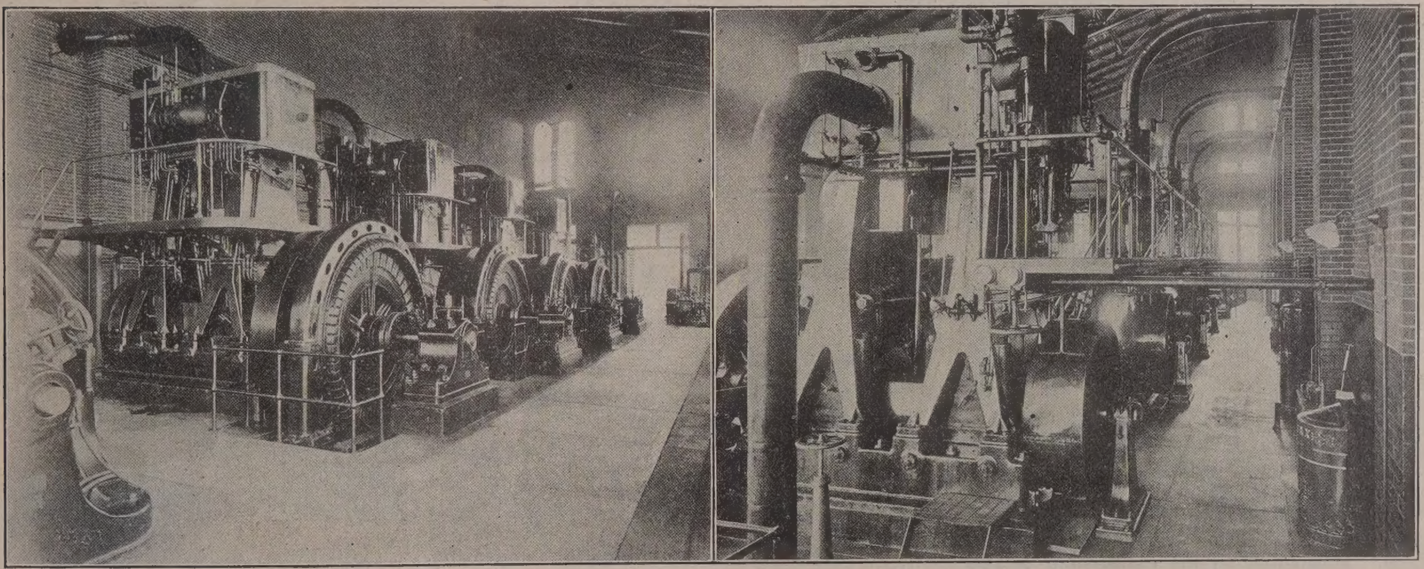
Compressed air is also largely used for cleaning car cushions, for which purpose outlets are provided at numerous points where hoses may be attached.

Power House Building and Distributing Tunnels.—The accompanying photograph indicates the general location of the power house. From this building a subway extends to the left where it turns at right angles continuing down the center of the trainshed with other branches to the several express buildings. This main tunnel aggregates 700 ft. in length, is 12 ft. in width, 9 ft. in height, and of concrete construction with steel roof beams.

The power house building has been rendered fireproof throughout by the use of concrete-steel construction, tile roof, steel roof trusses and concrete-steel coal and ash bins. It should be noted that the roof construction shown in the drawing represents a preliminary design which was later modified to allow of greater slope and a monitor in the boiler room. On all supported flooring, reinforced concrete arches are used. Solid floors are surfaced with concrete, as in the rear of the boilers. Gutters are here provided for conducting to a sump well the water used in boiler washing. At the rear end of the boiler room is located a small pump house addition containing heaters, feed pumps and fire pumps. Outside the building, opposite the coal elevator, is an elevated ash storage bunker situated directly over a spur track paralleling the building wall so that coal may be unloaded and ashes loaded from one position of the hopper car.

The power house occupies a total of 13,660 sq. ft. inside the walls, of which 53 per cent. is devoted to the boiler plant and 34 per cent. to the electric power machinery, the remaining 13 per cent. being occupied by the compressors. This is equivalent to 1.8 sq. ft. per e. h. p. for the electric power equipment and 2.62 sq. ft. per b. h. p. for the boiler plant. The 34 per cent. includes the floor space necessary for generating and exciter units, rotaries, switchboards, and some vacant space for extensions. The generating units alone occupy less than 19 per cent., including liberal passageways, or 1.35 sq. ft. per e. h. p.

Details of Engine Room Equipment.—The main power generating units are well illustrated in two accompanying photographs. Four units are at present installed, each of 500 h.p. normal capacity, and a blank steam connection has been provided for a fifth unit should it be found necessary to install one in the future. The engines are of a type specially developed by the Westinghouse Machine Co. for power station work, a medium power, high speed, compact and efficient engine, and one well suited to this particular service.


Front and Rear Views of Main Power Generating Units, St. Louis Terminal.

GENERAL DATA OF ENGINES.

Over-all dimensions; length 10 ft. 2 in.; height, 13 ft. 10 in.; width, 6 ft. 6 in.
Cylinders, h.p., 17 in. diam.; l.p., 27 in. diam.; stroke, 24 in.
R.p.m., 200; piston speed, 800 ft.
Volumetric ratio of cylinders, 1 to 2½.
Shaft diameter at bearings; crank, 7.5 in.; generator, 9 in.
Projected area of main bearings; crank, 67.5 sq. in.; generator, 189 sq. in.
Ratio connecting rod to crank; 5 to 1.
Normal capacity; 500 h.p.; maximum capacity, 750 h.p.
Weight of engine; 75,000 lb.; with fly wheel, 90,000 lb.
Weight of unit, 100,000 lb.
Weight per rated i.h.p.; engine, 180 lb.; unit, 200 lb.
Weight of unit per sq. ft. of footing, 266 lb.
Floor space required; engine, 82 sq. ft.; unit, 245 sq. ft.
Horse-power per sq. ft.; engine, 6.1; unit, 2.04.
Steam pressure, 150 lb.; exhaust pressure, atmosphere.
Capacity of generator, 350 kw.

The engines are capable of sustaining a continuous overload of 25 per cent. with a maximum of 750 h.p., or 50 per cent. for short periods. They were, of course, designed for non-condensing operation, having a cylinder ratio of only 1 to 2½. The speed is controlled by an automatic inertia shaft governor mounted within the flywheel at the throttle side of the engine. An economy of 20 lb. of steam per I. H. P. at full load has been obtained during tests conducted upon an engine of this size and type before leaving the works. These results are shown in the accompanying table and curves. It is of interest to note that the results shown have been obtained without infinitesimal clearances, valve arrangement, automatic low pressure cut-offs, steam jackets, receivers, or any of the refinements that are generally supposed to be responsible for economic performances.

As a matter of information only, a series of condensing trials were run. Although obviously out of its element, the engine showed a steam consumption of 16.2 lb. at a load of 430 i.h.p., and at all loads ranging from 300 to 550 h.-p., not over 16.7 per i.h.p. A few features of construction are of interest:

Abstract of Efficiency Test of Engine.

Brake Horse Power	136.1	267.3	391.5	508.0
Indicated Horse Power	186.7	321.5	432.5	553.6
Per cent. rated capacity	37.4	64.4	86.6	110.6
Mechanical efficiency	73.0	83.25	90.5	91.8
Water rate, total non-cond.	4980.	6985.	8775.	11130.
Steam per Brake h.p. hour	36.60	26.20	22.90	21.80
Steam per i.h.p. hour	26.63	21.70	20.70	20.01

Moisture—1.3%.
Steam pressure—150 lbs.
Reheater—none.
Jackets—none.
Valves—H. P. balanced type. L. P. double ported bell slide.
Revolutions per minute—200.
Cut-off—High pressure, variable.
Cut-off—Low pressure, constant.
Cranks—90°.
Tested by Sargent & Lundy.

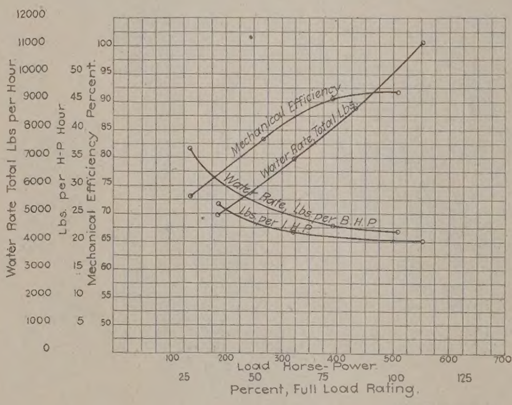
It will be observed that the continuous bed plate is not used for the entire unit, but that engine, generator and outboard bearings are supported by separate concrete piers built up from the common foundation. The bed plate, which is of the heavy box type, is designed so that the three crank pits may serve as oil wells to collect all oil drips which are then piped to a filter and returned to the oil reservoir. Each bearing may be adjusted from the outside of the bed plate by the wedge bolts shown in the photographs. By removing the cap and easing off the bearing wedge the lower shell may be slid out on top of the shaft for inspection. A coupling on the crank shaft located between the two cranks permits of the removal of the shaft without dismantling the engine.

All of the four engines are interconnected by a cast iron gallery which also surrounds three sides of each of the units at a height convenient to throttle and lubricators. Each engine may thus be operated from this gallery or from the floor as may be most convenient. The exhaust of the engine is controlled by a pedestal valve, so that the engine may be operated from one position. A small by-pass upon the main throttle valve provides for warming up the engine previous to starting, and a similar by-pass around this pedestal valve into the exhaust main allows the drip and condensed steam to be carried off while the engine is idle without manipulating the large exhaust valve.

Oiling System.—One of the features of the power plant is the complete manner in which the lubrication of the machinery is taken care of by automatic means. In the case of the engine oil, a simple gravity head is depended upon to insure a constant supply. Two 500-gal. tanks are located upon an elevated gallery in the boiler room. The height of oil in this tank is indicated by a gauge glass connection on the engine room wall. Oil is elevated to these tanks from the filter in the basement by a small duplex pump (in duplicate) and after passing through a small cone filter of perforated metal, is delivered to a 2½ in. brass oil main passing along the engine room with branches to each engine. After reaching a small cast iron reservoir on top of each engine, the oil descends to a main supplying the several manifolds, from which it is distributed to the various parts of the engine through sight-feed cups. As the oil head upon the system is constant at about 15 ft. an adjustment of all the feeds once made is permanent, and a single valve in the feed pipe controls the entire system at each engine.

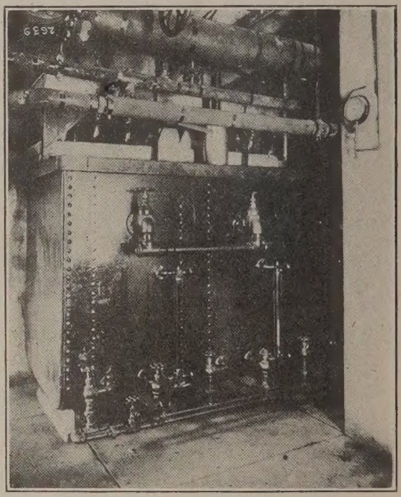
The oil filter referred to above is shown in one of the illustrations. It consists of a boiler iron tank divided into three compartments by baffle plates, these compartments being partly filled with water. Oil from the engine is first filtered through small canvas bags, twenty-seven in number, and in passing around the baffles the remaining impurities are removed and deposited in the bottom, from which they may be drawn off at outlets provided in each compartment, as shown. A live steam connection to each compartment is used only during cold weather to maintain the mobility of the oil by heating it to any desired temperature.

Cylinder oil is handled in a somewhat similar manner except that it is under boiler pressure. A steel tank of 75 gal. capacity and located in the basement is filled with cylinder oil through a funnel in the floor above, covered by a cast iron floor grating. City water pressure introduced into this tank elevates the oil to a riveted steel tank on the engine room floor, a check valve preventing the return when the water pressure is turned off. This tank is filled approximately once a week and when full, boiler pressure is turned on which forces the oil into a 1-in. main running along the edge of the engine platform, as shown, with branches at each engine serving throttle, receiver, cylinders and glands. Steam pressure is taken directly from the main steam header through a pipe loop carried up to the height of the roof trusses in the boiler room and back to the oil tank. This pipe loop is continually filled with condensed steam, and the differential pressure between boiler and throttle, combined with the static head due to the water column of approximately 20 ft., insures a good supply of oil to all parts of the engine. The automatic system does not, however, interfere with the usual methods of lubrication, as hand pumps are provided at each engine on both floor and gallery for the same purpose. The pressure tank may also be filled by hand if necessary, and the oil may be drawn off from this point through a convenient spigot. A 2½-in. pipe connects with the oil filter, so that if desirable the cylinder oil may be purified in the same manner as the engine oil.



The Engineering Record.

Performance of Engine Running Non-Condensing.



Oil Filter, St. Louis Terminal.

Gauge Board.—Another excellent feature of the engine room is the gauge board, which is of uniform size with, and installed as a part of, the electric switchboard. Upon this gauge board may be observed the operation of the several functions of the mechanical equipment, as follows: Boiler pressure, steam and exhaust heating, hydraulic supply and return, city water, and compressed air. All the above are indicating gauges. There are two recording gauges on air pressure, for general uses and for the signal system. At present these services are combined, but provision has been made for separating them in case of mutual interference.

Air Compressors.—The two compressors, which are of the compound two-stage type, with large intermediate receiver, deliver compressed air through independent mains to a condenser house near by. Here are installed two large air-storage tanks automatically drained at the bottom, which finally distribute to four sets of condensers, where the air is cooled and the moisture precipitated before it is utilized in the switching system. These condensers consist of thirty-eight vertical 2-in. pipes in parallel between receiving and discharge headers. Each of the compressors has capacity to handle 2,000 cu. ft. of free air per minute.

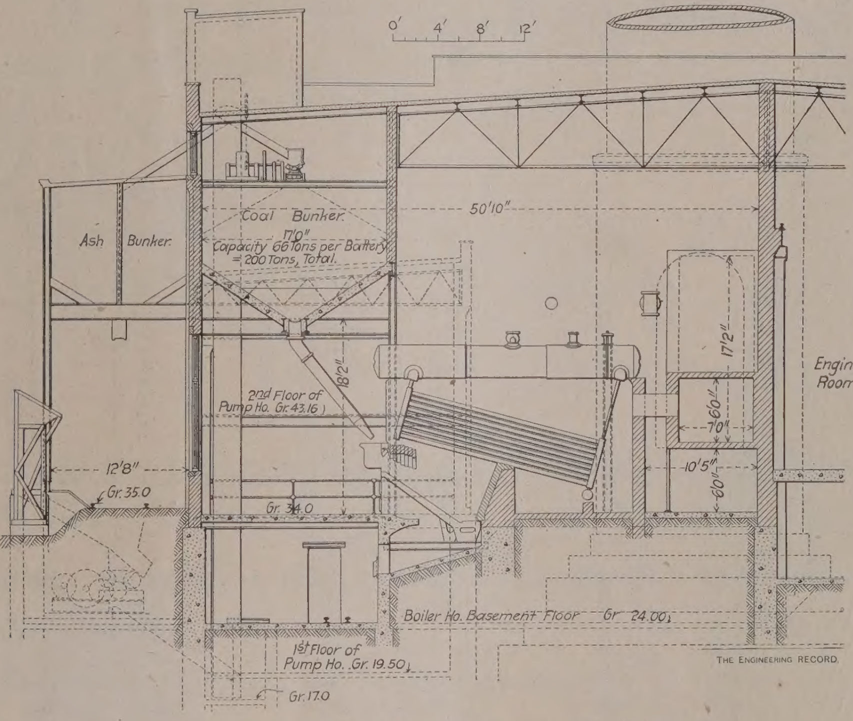
Hydraulic Elevator System.—The pumping machinery necessary for supplying elevators is located in the basement beneath the switchboards. Each of the pumps is of the duplex pressure pattern of 120 gal. capacity and automatically controlled by Mason regulators. One thousand gallons per hour will ordinarily be required for operating the thirty-nine elevators. The hydraulic system is designed to stand 750 lb. pressure per square inch, and either oil or water may be used. For the former a storage tank of 14,000 gal. capacity is installed in an underground chamber connecting with the tunnel. All of the hydraulic piping is constructed with forged bends.

A 6-in. line conveys the high-pressure oil to the elevators and an 8-in. line returns it to the storage tank.

Distribution.—In the main tunnel a section 3 ft. 6 in. in width is reserved for the distributing piping and electric conduits. Only about 10 per cent. of the tunnel area is, however, actually used. A typical section of the distributing system comprises the following: 20-in. low-pressure steam for heating, 8-in. heating return, 6-in. steam for car heating, 4-in. steam to kitchen, 6-in. hydraulic supply, 8-in. hydraulic return, 3-in. compressed air, 27 tile cable ducts laid in and covered with cement; also telephone and signal wires.

Loricated pipe conduit is employed throughout the plant from the junction of conduit and power house cables, also for electric wiring. The various runs of piping in the tunnel are supported by flexible roller hangers of simple design. These consist of a short length of iron pipe hung from the roof beams by two eyebolts and covered by a loosely fitting pipe roller, upon which the distributing main rests. All of the pipe mains are usually anchored at approximately the middle point of straight runs. In one case, however, the length of the run has made necessary the use of a special designed expansion joint which combines its principal function with that of an anchor.

Details of Boiler Room Equipment.—The accompanying section of the power house shows clearly a typical section of boiler and mechanical stoker setting, also the flue and bunker construction and the arrangement for handling coal and ash. The two boilers in each battery are suspended from a structural framework free from the setting. At the front, independent supporting columns are unnecessary, and the drums are hung from gusset plates riveted to the longitudinal girder supporting the side wall of the coal bunker.


0' 4' 8' 12'
Ash
Bunker.
Coal Bunker.
17'0"
Capacity 66 Tons per Battery = 200 Tons, Total.
50'10"
18'2"
17'2"
2nd Floor of Pump Ho. Gr. 43.16
Engine Room.
6'0"
7'0"
10'5"
6'0"
12'8"
Gr. 35.0
Gr. 34.0
Boiler Ho. Basement Floor Gr. 24.00
1st Floor of Pump Ho. Gr. 19.50
Gr. 17.0
THE ENGINEERING RECORD.

Cross-Section of Boiler Room, St. Louis Terminal Station.

The stokers are of the well-known Roney inclined rocking grate type, with coking arches which assist in gasifying the green fuel, thus preventing smoke. They are operated by two small Standard engines. Each engine normally operates half of the stoker equipment, although couplings are provided in the line shaft so that their connections may be interchanged if necessary. Coal is fed by gravity from the bunkers above. By means of their flaring ends the chutes serve to keep the stoker hoppers always full, and the descending streams of coal automatically seal themselves. These chutes may be swung back when the boilers are to be cleaned, at which time the gates at the top are used to shut off the coal supply. Ordinarily these are left open.

A single vertical conveyor handles both ash and coal, which is distributed by a deflecting gate at the top, the ashes gravitating to the ash bunker outside, the coal to the belt conveyor traversing the length of the coal bunkers. Ashes drawn from the stoker pit are conveniently transferred by means of Koppel cars to a hopper in the floor communicating with the elevator boot, and covered by a cast-iron grating. Coal may be delivered from hopper cars either through the crusher or around it. Provision is also made for receiving coal from wagons. In order to manipulate one or several cars standing upon the siding without the assistance of a locomotive, a steam-driven winch is used, located at the end of the boiler room, as indicated in the illustration of that room. A cable from this winch extends for some distance into the yard and around a pulley, doubling back along the building wall for such a distance as may be necessary to pick up the car in question.

A considerable saving in the quantity of water required for cleaning boilers is made by returning the wash water to a sump well through the floor gutters previously mentioned. After settling, the water is skimmed while overflowing into a tank, from which it is again pumped to the boilers. By this means the entire row of ten boilers may be washed with one change of water.

Piping.—Two steam mains extend the entire length of the boiler room, one a 12-in. header and the other a 6-in. auxiliary. The main header is sectioned by valves between each battery and at the center, while the auxiliary is sectioned only at the center. The mains are tied together at both ends and also near the center. Main engines, exciter engines, air compressors and hydraulic pumps are ordinarily supplied from the main header, but in case of accidents, one exciter, one compressor and the hydraulic pumps may be driven from the auxiliary main. Combination globe-check valves in the boiler risers prevent back flow of steam in case of accident to any one boiler. The entire pipe system is suspended from the roof trusses, long runs being anchored at the center. In the case of branches, necessary lateral flexibility is secured by 6-in. lengths of screwed pipe at the junction with the main. The auxiliary main is fed by 2-in. connections, with check and valve tapped directly into each boiler header. This practically debars the possibility of steam supply being entirely shut off from the high-pressure system.

Water pockets are purposely formed at the ends of each steam main, which are drained by a steam loop and Holly gravity return system. This system also drains all valve pockets, engine throttles and the entire high-pressure system of piping, the drips being automatically returned to the boilers by the differential pressure of the system. All important valves may be operated from iron galleries supported from the roof, as shown. These are 24-in. wide and are constructed of pieces of flat iron bars set on edge with 1-in. spacing. Iron ladders and stairways of equally substantial construction are also used throughout the boiler room.

Steam due to boilers blowing off is prevented from escaping into the boiler room by a conical discharge main connected to the several safety valves. This main varies from 4 to 12 in. in diameter and runs the entire length of the boiler room, paralleling the other mains.

Unusual precautions have been taken in insuring against interruptions of feed water. Two duplicate 6-in. feed mains extend along the roof of the ash tunnel parallel with the boiler fronts. At each battery, two 2½-in. risers form a loop from main to main with branches to the boiler drums. This arrangement enables the feed for either boiler to be drawn from either main.

The main exhaust line, a 16, 18, and 20-in. conical main, rests directly upon the engine room basement floor. It discharges into the heating system at one end and into the feed water heaters at the other. A 20-in. Cochrane separator removes the greater part of the oil from the steam used for heating purposes. This exhaust system, likewise the feed piping and heaters, are covered with magnabestos insulation.

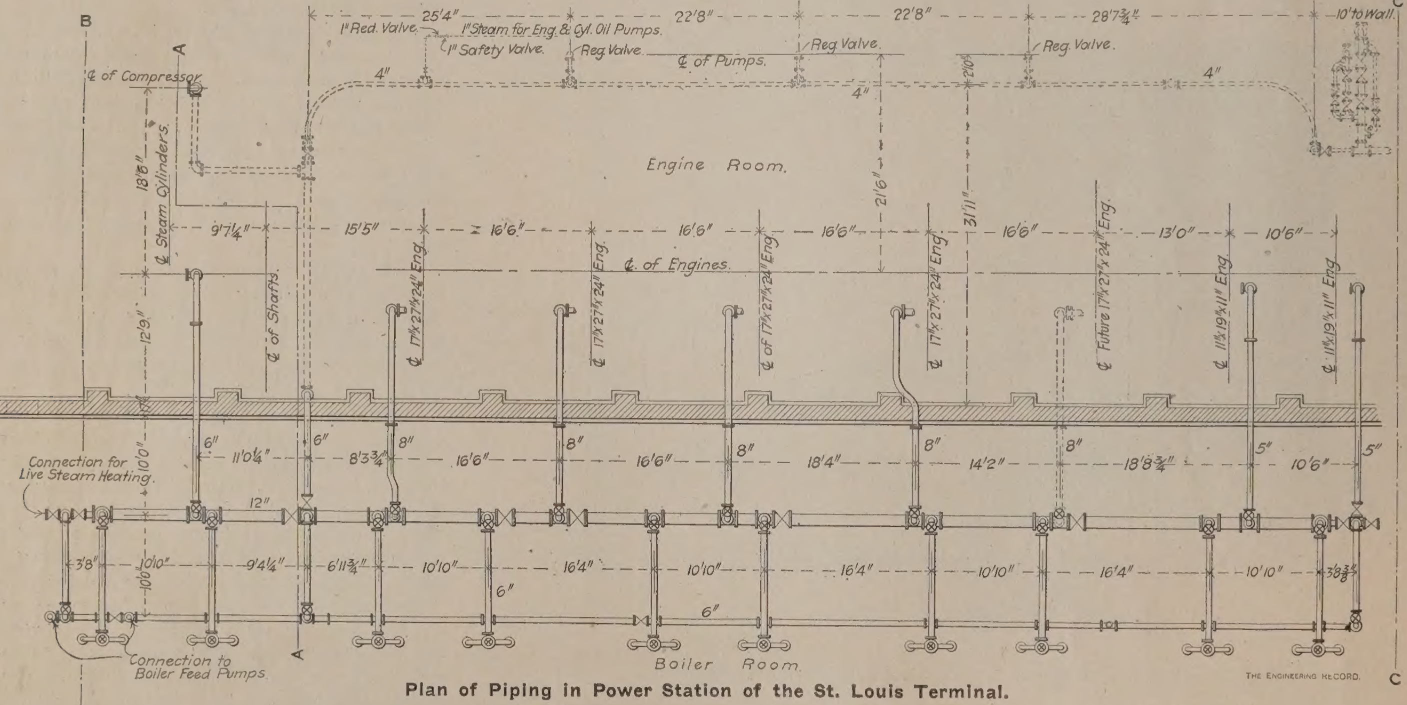
During cold weather the exhaust steam may be supplemented by live steam from two sources, a branch from the end of the main header and an extension of the pump line, which latter may either be supplied from the main or the auxiliary steam line.

Details of Electrical Equipment.—A very complete switchboard controls the electrical system. It comprises several sections devoted to main generators, exciters, rotary converters, power and lighting feeders, and arc system. Each panel controls a single machine or feeder, which arrangement results in great simplicity, ease of operation and absence of danger from confusion. Oil switches (Westinghouse type D) are used on all the high-tension circuits and small series and shunt transformers in the meter circuits, in order to avoid the use of high-tension current directly on the meters. Arc circuits are controlled entirely by plug switches. The generators are synchronized with the aid of a Westinghouse synchroscope mounted upon a swinging panel at the end of the board, or by the usual synchronizing lamps. In breaking the generator fields the current is first shunted through an iron resistance until it has been reduced to a harmless nature, when it may be opened by the switch. The majority of the instruments are of the Westinghouse long scale, round dial type, but where confusion would be liable to result between alternating current and direct-current meters, dissimilar designs are used.

Operation.—The regular operating force of the power station consists of an engineer-in-chief, an assistant engineer, two engine room and two boiler-room attendants. It is good evidence of the value of the several automatic and labor-saving appliances used in the plant that this small force of men is capable of successfully handling an equipment of such comprehensive character where continuity of service is an item of such extreme importance.

At the appointed time for transferring the power supply of the terminal from the old power house to the new one above described, no hitch or interruption occurred further than the opening and closing of switches. The new equipment and distributing system had been installed complete and ready to operate before the old plant was put out of service.

The establishment of the power plant, as well as the power reconstruction work at the terminal, has been entirely carried out by Messrs. Westinghouse, Church, Kerr & Co., acting as consulting engineers for the Terminal Railroad Association on this particular work.



Plan of Piping in Power Station of the St. Louis Terminal.

Tests of Auxiliaries at the Cambridge Electric Light Station.

In the early part of 1903 an extended series of tests of the new power plant of the Cambridge Electric Light Co., of Cambridge, Mass., was conducted by students of engineering in Harvard University, and many of the results were incorporated in a paper presented last summer to the American Society of Mechanical Engineers by Prof. Lionel S. Marks, assistant professor of mechanical engineering at Harvard. In that connection records of some 28 different tests on nine engines in this and other stations were discussed with reference to their bearing on the use of superheated steam and on the use of reheaters in compound engines of large size, and a full abstract of the paper, with a detailed table of the results of the tests, was printed in The Engineering Record of June 4. Professor Marks has now contributed further details of the tests of the engines in the Cambridge station, in an article in the "Harvard Engineering Journal," and from this some figures are obtained on the performance of the auxiliaries. For general data regarding the performance of the engines themselves, reference may be had to the issue mentioned, while the arrangement and proportions of the machinery is illustrated in an article describing the plant published in the issue of Nov. 1, 1902.

Tests of Auxiliaries at the Cambridge Electric Light Station.

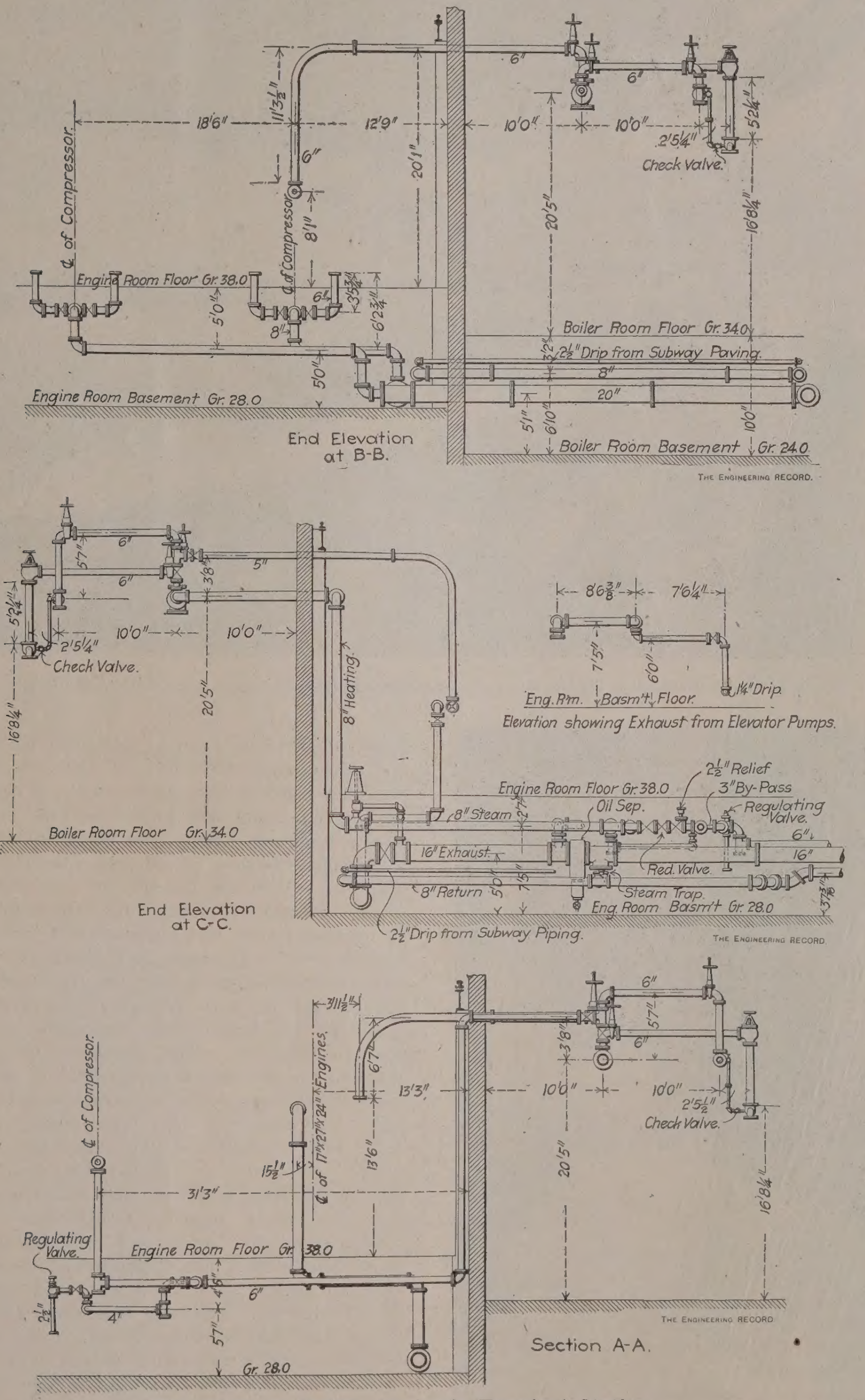
	Engine No. 1.		Eng. No. 2.	Engine No. 3.			
Indicated horse-power	714.7	715.5	857.6	2,184	1,195.9	716	1,198.1
Number of boiler	2	2	4	3 & 4	4	4	4
Water per hr. to main boilers, lb.	10,314	9,680.7	11,523	27,701	14,850	9,518	15,697
Leakage per hr. from main boilers, lb.	212	212	265	405	239	239	239
Water per hr. to auxiliary boiler, lb.	2,279	1,387.7	3,077	4,110	3,252	2,625	2,896
Leakage per hr., auxiliary boiler, lb.	80	80	80	80	80	80	80
Vacuum in condenser, in. of mercury	26.15	26.27	26	25.4	26.4	26.4	25.8
Temperature:							
Of steam at main boiler, deg. F.	447	450.8	430.7	441.5	446	439.5	450.1
Fall of, bet. boiler & throttle, deg. F.	16	16	18.8	18.4	19.3	25.7	18.8
Of low-pressure exhaust, deg. F.	125.7	125.2	133.9	133.7	125.4	121.5	129
Of cold feed, deg. F.	53.6	54.1	54	56.2	60	63.9	62.1
Of feed leaving heater, deg. F.	124	125	130.6	131.5	125	120.8	128.5
Of feed leaving aux. heater, deg. F.	212.9	201	210	201.1	219.7	218.4	218.7
Of feed leaving economizer, deg. F.	215.4	223	245	252.1	234	237.9	255.0
Of injection water, deg. F.	55.3	56.2	55	62.1	69.6	66.6	68
Of condenser discharge water, deg. F.	87.8	90.2	85.8	95.5	92.1	84.5	94.6
Calculated ideal feed temp., deg. F.	133	144	137	162.5	143.3	143	131.6
Heat per lb. of steam above ideal feed temperature, B.t.u.	1,124.8	1,115.7	1,111.3	1,091.8	1,112.8	1,106.6	1,126.5
Steam per i. h. p. hr. in auxiliaries, lb.	3.08	1.83	3.50	1.85	2.67	3.56	2.36
Steam per kw. hr., engine and aux., lb.	25.08	22.21	24.7	20.3	22.6	28.3	23.36
Percentage heat given to feed water:							
By main heater to feed-water	5.8	5.8	6.3	6.2	5.3	4.7	5.5
By auxiliary heater	7.3	6.2	6.5	5.7	7.8	8.1	7.4
By economizer	.2	1.8	2.9	4.2	1.1	1.6	3.0
By all heaters	13.3	13.8	15.7	16.1	14.2	14.4	15.9
Coal per i. h. p. hr., main engine, lb.	1.43	1.34	1.33	1.27	1.24	1.31	1.31
Same, for main engine and aux., lb.	1.75	1.52	1.685	1.45	1.51	1.67	1.55
Coal per kw.-hr. main eng. and aux., lb.	2.54	2.25	2.50	2.06	2.29	2.87	2.37

The seven columns in the accompanying table correspond to tests Nos. 22 to 28, inclusive, in the article of June 4. Engines Nos. 1 and 2 are of the same size, with 18 and 38-in. cylinders and 42-in. stroke, and No. 3 has 31 and 64-in. cylinders and 48-in. stroke; all were built by Messrs. McIntosh, Seymour & Co. The piston speed for the smaller engines averaged from 828.8 ft. to 834 ft. per minute in the three tests enumerated, and the piston speed of the large engines ranged from 935.2 to 954.7 ft. per minute. The engines are fitted with Blake jet condensers, and their steam consumption had to be determined by measuring the boiler feed. The boilers were shut off from the Holly return system and had their blow-offs disconnected. The steam on its way to the engine under test went first to a section of the main steam header, which was isolated by gate valves from the rest of the header. These gate valves were tested for tightness with full steam pressure on one side and atmospheric pressure on the other, and were found practically tight in all cases. In order, however, to prevent even slight leakage the steam pressures were kept the same on both sides of the valves during the tests. The steam supply to the engines was superheated so that the steam pipe drips could be closed.

To determine the total leakage from the boilers and steam pipes the fires were allowed to burn down at the end of the run and were kept in such a condition as to maintain the steam at the test pressure. The rate of lowering of the water level in the boilers gave the necessary information. The auxiliary engines were supplied from an auxiliary boiler. The feed to the auxiliary boiler went through a separate pump, and its amount was determined by subtracting the weighed amount going to the main boilers from the meter reading of the total feed to the boilers. As the meter calibration was found to be rather variable, the amount of water so determined going to the auxiliary boiler is possibly in error by a small amount. The steam pressure in the main and auxiliary boilers was kept the same.

The weight of water pumped to the main and auxiliary boilers is given in the table, and also the leakage, so that the difference in each case gives the amount of steam delivered. Each boiler is of the Babcock & Wilcox water-tube type, with 3,964 sq. ft. of heating surface, and 125 sq. ft. of superheater coils. The temperature of the steam at the main boilers is given in the table, and the drop in temperature between boiler and throttle, so that the difference gives the steam temperature at the throttle. The main heaters, as explained in the descriptive article printed in 1902, contain 165 sq. ft. of heating surface in the case of those for the smaller engines and 334 sq. ft. in the larger heater, and they are all of the type made by the Whitlock Pipe Coil Co. The auxiliary heater contains 500 sq. ft. of heating surface and the economizer is of the Green type, of standard-size tubes arranged in two groups, one 240 and the other 280 in number. In connection with the performance of the latter, no record of the temperatures of the flue gases are available. The auxiliary machinery includes the 8x12x6.5x 12-in. feed pumps, vertical twin type jet condensers, and an engine-driven exciter. The steam consumption for the auxiliaries is given in the table.

The radiation and conduction losses in a steam engine were referred to by Prof. Marks. The data collected were sufficient to allow for determining by subtraction the amount of the loss of the character stated for the high-pressure cylinder and it was found to be ½ to 1 per cent. of the total heat supply to the engine at full load. As the low-pressure cylinders were as carefully lagged as the high-pressure cylinders, the author placed the value for the total radiation and conduction loss at 1 to 1½ per cent., the smaller percentage applying to the larger engine, of 2,320 h.-p., and the other to the smaller engines, of 760 h.-p.



Elevations of Piping, St. Louis Terminal Station.

The Money Value of Engineering Advice.

It is sometimes stated that engineering advice is valuable only on strictly technical subjects, and it is not well to rely on an engineer for suggestions concerning broad features of manufacturing policy. While such problems cannot be solved by all engineers, any more than the most important legal questions can be safely entrusted to all lawyers, the engineer is often able to save great interests from financial disaster. The following examples of this were given in an address prepared for the Iowa State Manufacturers' Association by Prof. Wm. G. Raymond, head of the engineering departments of the State University of Iowa.

A great printing company, employing many men, and operating with an antiquated power transmission system, became dissatisfied with the results it was securing and employed an engineer to remodel its plant. With the completion of the improvements he suggested came increased production for the same wage cost, higher-grade work, and better satisfaction among the old employes.

A Canadian company operating weaving and knitting mills had a number of New York stockholders who were dissatisfied with the results of the operation. They sent a young, technically-trained man to examine into the workings and to report with advice. He was of fewer months experience than the years of the practical managers, and this is what he found: A plant with non-standard machinery, with some clumsy home-made machinery, all calling for costly repairs, with small production per wage-earner-hour, costly running of all departments overtime when but a single department need so run, etc., etc. Under his advice has been undertaken a complete reorganization of the operating department, the installation of modern high-speed standard machinery, the employment of better foremen, and the arrangement of power transmission by departments.

A great company, operating plants in nine States and Territories, and doing a business of $15,000,000 yearly, became financially involved and sought advice from an engineering expert. Upon examination this technical man discovered that but 13 per cent. of the operating mechanism was paying, and that departments that were losing money were being shown to be profitable, just because the technical questions in connection with the business were entirely misunderstood by the managers and accountants. Under the advice of the expert these departments are now being placed in a satisfactory condition.

Another great manufacturing concern with its allied corporations—nine in all—became hopelessly involved. Some of the concerns were profitable undertakings, but were loaded with the combined obligations. Here you will say was a task for an accountant—but the accountants could not straighten out the tangle. An engineering expert who was asked to advise made a thorough investigation of every phase of the question, discovered and reduced the difficulties, so that now the profitable enterprises are making good returns on the invested capital.

Yet another large corporation of London, England, conducted extensive mining operations for the raw supplies and partly manufactured supplies of a New York manufacturing company. For years the profit per market unit was only 10 cents, the cost of production being 65 cents, the value of the produced material 75 cents. An engineering expert was asked to examine into the workings of the concern to learn if better results could not be obtained. Under his advice and direction the concern was reorganized, the processes changed, and the mills rebuilt, the cost per market unit on product was raised to $1.20 and the market value to $1.75, an increase of 550 per cent. in the profit per unit.

A large manufacturing company of an eastern city operating factories for the handling of special fibers, planned to move to a location where water power could be secured, which it was thought would be of advantage in the manufacture of paper. But before moving, the advice of an engineering expert was sought. He reported the water power excellent, but for other reasons advised against the change. The superintendent and foremen strongly urged the change. Fortunately the stock holders accepted the advice of the technically trained men, for now, three years later, the notion of the change seems particularly absurd, and the advice of the technically trained men really saved a disastrous step.

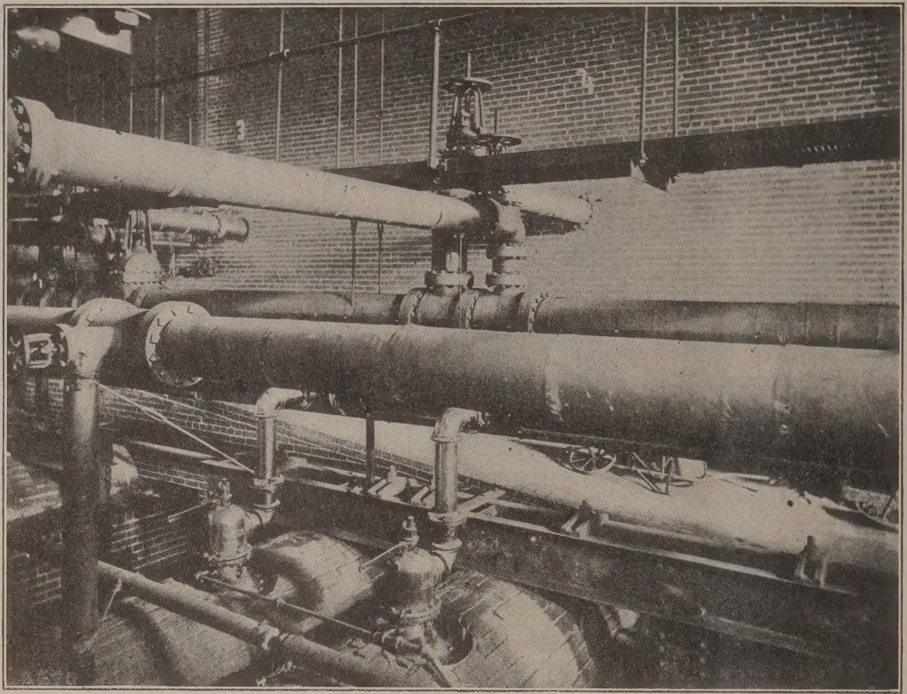
Crossing Railroads by Power Transmission Lines.

A problem as interesting and important to the engineer of a railway, entrusted with the preservation of its right-of-way in a safe condition, as to the builder of electric power systems, is presented when the transmission lines must be carried over railway tracks. This is particularly true with high-tension lines, and for this reason some statements recently made by Mr. P. M. Lincoln in the "Journal" of the Electric Club of Pittsburg deserve attention.

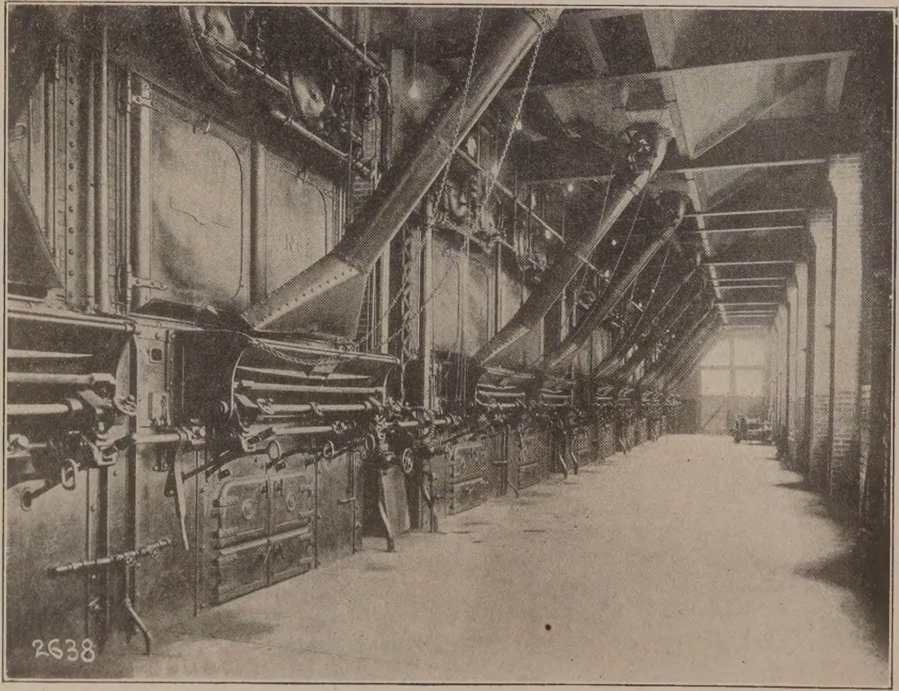
Where a transmission line crosses a railroad right of way, the railroad, being the older enterprise, will impose certain conditions to be met by the transmission company in order to secure safety to the railroad's traffic. It may be that an underground crossing will be prescribed, or it may be an overhead crossing of a more secure nature.

In conveying cables underground, in the present state of the art, line construction above 20,000 volts is an impossibility, in Mr. Lincoln's opinion. Even at this voltage it is a very difficult requirement for the transmission company to meet. There are but two places, so far as he knows, where so high a pressure as 20,000 volts is in use on underground cable sections. It is also to be noted that while the influence of short sections of cable on long aerial lines is at present unknown, it is more than likely that experience will develop the fact that the protection of these short lengths is more difficult than the protection of an entire underground system at the same voltage.

The only way, therefore, in which potentials over 20,000 can be carried underground, is to make an opening under the right of way, of sufficient size to permit aerial construction in practically the same manner as it is now carried on the poles, except, of course, that the height need not be so great and the dimensions between the wires might be somewhat reduced. At the present time, therefore, a ruling by a railroad company that no transmission lines should cross its right of way overhead, would practically exclude all transmission lines above 20,000 volts, and make it impossible for them to cross with their wires.



Main and Auxiliary Steam Line and Safety Valve Discharge Line Above Boilers.



View in Boiler Room, St. Louis Terminal, Showing Winch at End of Aisle.

Two distinct dangers menace the railroad company's property at the point of crossing high-tension lines, one of which is electrical and the other mechanical. The electrical danger obtains whenever the wire comes near enough to the ground, or to trains passing under them, that persons on the right of way or on the trains can by any means come in contact with them. The mechanical danger is due to the transmission cables getting across the tracks or in the way of the trains, and is entirely independent of the danger from shock. So long as the cables can be kept a safe distance from the ground, say 30 ft., neither of these dangers will exist. It is only when the cables come down either partially or completely that there will be any danger to a railroad company's traffic.

The question, therefore, resolves itself into this: How can the cables of the transmission company best be kept in place, and should they by any means break, how can the electrical charge be removed from them at that time? The best mechanical construction, it seems to Mr. Lincoln, consists of the transmission cables alone, provided they are properly put up. Any structure, such as a net, placed upon the same poles, is bound to throw an additional mechanical strain upon the structure with the result that as a whole it is weakened and not so able to bear abnormal mechanical strains as the transmission cable alone. In other words, the best bridge that can be put across the right of way over which the transmission company is to send its power, consists of the transmission cables themselves, and any additional mechanical devices hung upon this structure must necessarily tend to weaken the structure and thus defeat its own purpose. Mechanically, therefore, the transmission line alone is the best construction. This statement does not refer to the mechanical construction which is typically represented by the average telegraph line. The telegraph line built usually of a small solid conductor strung very tight, when coated with snow or ice has not nearly so large a factor of safety as that of a transmission line when properly constructed. The transmission line conductors are usually of large cross-section, are stranded and therefore have an ample factor of safety, even though coated with ice. The only dangerous feature, which first-class mechanical construction does not reduce to a minimum, occurs then, and then only, when the transmission line comes down on the right of way of the railroad company with the electrical charge still upon it. A very effective method of overcoming this difficulty is to place on each adjacent pole a grounded metallic arm to reach some distance out from the pole and come close up underneath the wires of the transmission line in such a manner that should a wire break at the right of way, or should it suddenly sag, it will come in contact with the metal arm and be thereby grounded.

In order to obtain the best mechanical construction, Mr. Lincoln says, it would be well to adopt the following specifications covering the span which crosses the railroad right of way, as well as the three or four adjacent spans on either side.

The distance from the top of the rail to the lowest point of the transmission line shall in no case be less than 30 ft. This specification need only apply to the right of way spans and need not necessarily apply to the adjacent spans.

In no case shall the size of the conductor which crosses the right of way be less than 0.1 inch in cross-section.

The form of the conductor shall be that of a stranded cable, the number of strands being at least nineteen.

Only sound poles shall be used in this construction and they shall have a top diameter of at least 9 in.

The two poles adjacent to the right of way shall be braced in such a way as to make it impossible for them to fall toward the tracks.

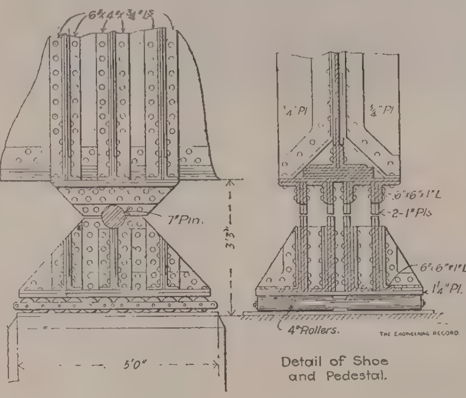
Two poles adjacent to the right of way shall be provided with double cross-arms and the transmission lines fastened to the insulators in such a way that it will be impossible for the transmission line to slip through.

The proper way to handle this problem, therefore, is to insist upon first-class mechanical construction of the pole line at the point where it crosses the railroad company's right of way, and to take the further precaution of putting up the grounded metallic arms.

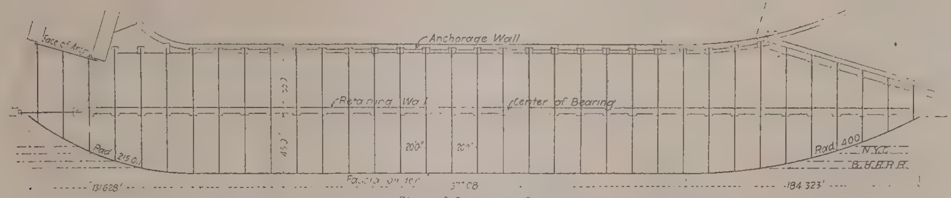
THE LIMITING SPEED OF GEAR WHEELS, figured for the pitch circle, in feet per minute, is placed by Mr. W. H. Thornbery in a paper read before a recent meeting of the Birmingham Association of Mechanical Engineers as follows: Ordinary cast-iron wheels, 1,800; helical wheels, 2,400; mortise wheels, 2,400; machine-moulded cast-iron wheels, 2,000; machine-moulded steel wheels, 2,500; machine-cut wheels, 3,000.

A Boulevard Supported on Cantilevers.

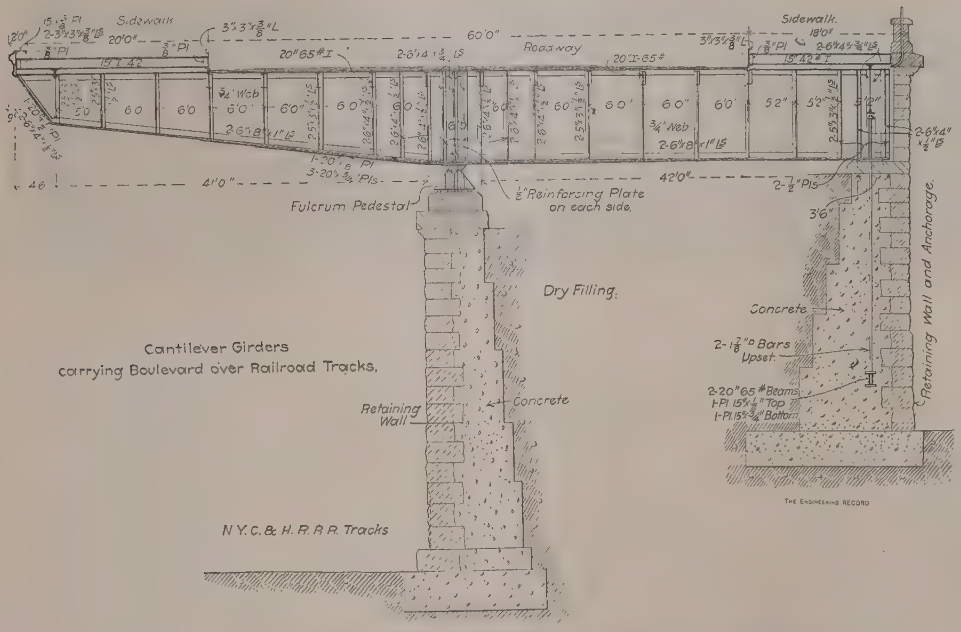
The northern extension of Riverside Drive along the Hudson on the west side of Manhattan Island, New York, is from 40 to 60 ft. above the adjacent tracks of the New York Central & Hudson River R. R., which lie in the narrow space between it and the river. Trinity Cemetery extends to the right-of-way of the railroad company, where the west property line was bounded by an old retaining wall about 15 ft. in height, with a nearly vertical face close to the tracks. A strip of land parallel to this wall and 50 ft. in width was all that could be secured from the Trinity authorities for the driveway, and as it was impossible to move the railroad tracks, difficulty was experienced in providing the minimum width of 150 ft. for the driveway. This was finally accomplished by building a steel platform about 693 ft. long from end to end of the cemetery to support the driveway.



Detail of Shoe and Pedestal.



Plan of Cantilever Girders



Cantilever Platform Carrying Riverside Drive over Railroad Tracks.

This platform is 100 ft. wide for 377 ft. in the middle, where the driveway is on a tangent, and is narrower at both ends, where the driveway curves inward and away from the railroad tracks. It consists essentially of a bridge floor carried on a system of transverse cantilever plate-girders 10 ft. deep, 100 ft. long, and 20 ft. apart on centers. They are all seated at or near the middle point on the coping of the retaining wall about 60 ft. above the surface of the adjacent tracks. This support serves as a fulcrum, beyond the center of which one end of each of the middle girders cantilevers 48½ ft., carrying part of the roadway and one sidewalk above the railroad tracks. The other end of the girder is supported on a retaining wall for the east side of the driveway, which has an average height of about 40 ft. above the present surface of the ground in the cemetery. Each girder is anchored at this end by a pair of long vertical rods 1⅞ in. square with upset ends.

Both retaining walls are of concrete faced with rock-faced granite ashlar, battered 1:12 and offset on the rear in steps 18 in. wide, and carried down to solid rock. The girders have ¾-in. web-plates and pairs of 6x8x1-in. flange-angles reinforced by 20-in. cover-plates ¾ in. and ⅞ in. thick. At the fulcrum the rib is reinforced to a thickness of 1¾ in. for a length of 12 ft., and has several pairs of large vertical stiffening angles which virtually form a column connecting the top and bottom flanges on the center line of the bearing. The bearing is made with a four-web shoe having a base-plate nearly 3 ft. wide. This projects about 7 in. each side of the bottom flange-plate and is stiffened on the edges by the lower ends of special transverse diaphragm plates and the bent ends of the vertical web-stiffeners of the girder which are connected to it, as shown in the detail. The shoe has half-hole bearings on a 7-in. pin in the top of a pedestal with a 4x4½-ft. base, which is seated on a nest of twelve 4-in. rollers secured by the ordinary top and bottom guide plates.

At the anchor end of the girder horizontal bearing is provided for the anchor rod on each side of the web on the upper ends of pairs of vertical angles which distribute the reaction stresses through rivets in the girder web. The rods are about 30 ft. long, and their lower ends pass between the webs of a pair of 20-in. I-beams, and their nuts engage bearing plates on the lower flanges of the beams. The beams are spliced together to make a continuous member built into the rubble masonry of the retaining wall and sealed with grout or concrete. The girders have an estimated weight of 50 tons each. They are connected by three lines of lattice-girders at right angles to them at both ends and at the fulcrum. These girders are about 8½ ft. deep for the center line, 5½ ft. deep for the outside line, and 4½ ft. deep for the anchorage line, all of them having their top flanges at nearly the same level as the top flanges of the main girders. The fulcrum line does not carry any portion of the roadway, but the two end lines help carry the transverse beams for the sidewalks. The girders are also connected by a series of longitudinal 20-in. I-beams 6 ft. apart for the 60-ft. roadway, and by X-bracing of six single 5x3-in. and 6x3-in. angles in the planes of the top flanges. At the ends of the platform the lengths of the girders are decreased and their dimensions vary accordingly. The total estimated weight of steel in this viaduct is about 4,000,000 lb., and it conforms in materials, tests and shop work to standard railroad-bridge specifications.

Mr. F. Stuart Williamson is consulting engineer for the Riverside Drive and designed the viaduct, which will be erected under his supervision. The contract for the shop work and erection of the viaduct has been awarded to the McClintic-Marshall Construction Co.

Fiberloid Company's Plant from the South, during Construction.

The New Works of the Fiberloid Company, at Springfield, Mass.—I.

An unusually extensive and interesting plant for the manufacture of a single specialty is the new establishment of the Fiberloid Company at Springfield, Mass., recently completed and now partially equipped. Planned and built with careful attention to the peculiar requirements of the process, special precautions to minimize the fire hazard and a regard for architectural appearance, the works comprise twenty brick buildings of slow-burning mill construction or of a fireproof type, and have a total floor area of 4½ acres. The works are located on a site having good facilities for shipping by railroad, and an abundant supply of excellent water close at hand. The buildings are equipped with electric drives, two steam distribution systems, heating, ventilating and refrigerating systems, automatic sprinklers on both wet and dry systems, large water filters, incandescent electric lights and up-to-date plumbing. The main pipes and wires are placed in an uncommonly spacious tunnel, 800 feet long, extending from the power-house along the fronts of several of the most important buildings. The general arrangement and some details of the plant are shown by the accompanying illustrations.

General View of the New Works of the Fiberloid Company.

Fiberloid is one of several manufactured substances used for similar purposes and popularly called celluloid, without discrimination. Like celluloid, fiberloid is made into collars, cuffs, toilet and household articles and a great variety of novelties.

The present company, made up of a group of men who, under various names and with some changes of organization, have been engaged in this line of manufacturing for nearly twenty years, is the outcome of a reorganization effected in 1894, and for some years has been operating a smaller plant in Newburyport, Mass. Owing to the growth of the business, it became necessary to have larger works, and, as the majority of the interested parties were Springfield men and a suitable site with economical arrangements for power could be secured in that city, it was decided to engage Mr. Fred Sumner Hinds, mill architect and engineer, of Boston, to design a modern and commodious plant to be erected there.

Ground was broken for the new works March 23, 1903, all the roofs were tight by December 1, and the company began installing machinery before Christmas.

Location and Arrangement.—The works occupy a piece of land of 16½ acres area, approximately triangular in shape, about 1,480 feet long and 500 feet wide at the base, bounded on one long side by the Chicopee River and on the other by the Athol branch of the Boston & Albany Railroad, and situated in the suburb known as Indian Orchard. The proximity of the river assures an abundant supply of water for steam-making, condensing, fire-protection, hydraulic power, drinking and manufacturing and sanitary purposes, and a 30-inch main of the city water works passes through the grounds. The trains on the branch are infrequent, but the plant is only a few miles from the main line through Springfield. A spur for inward freight has been laid into the yard. The occupied portion of the lot is substantially level, sloping gently from the railroad to the river bank. The lowest part of the yard is about 6 feet above the highest reported flood level.

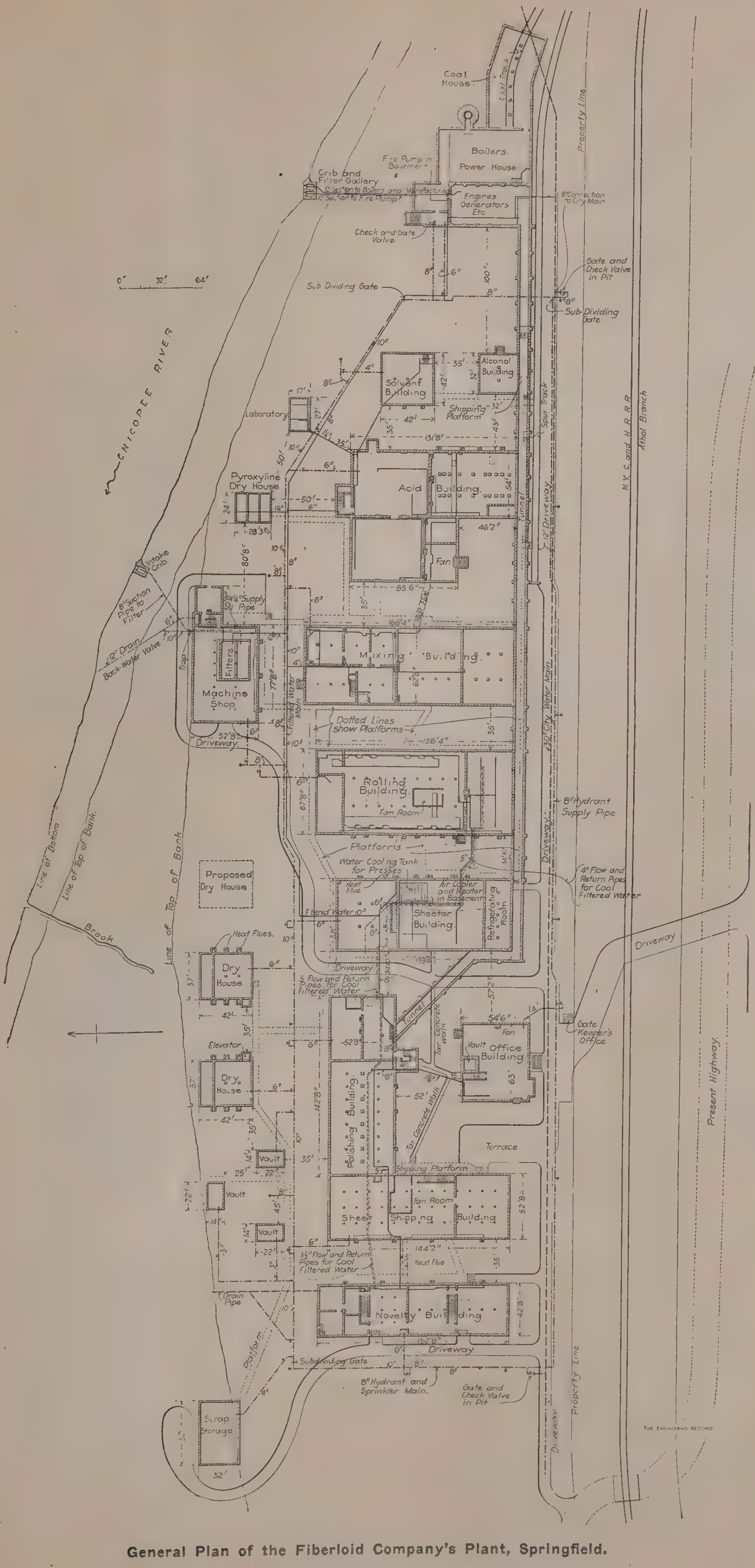
The manufacture of the fiberloid is attended with greater fire risk than many other industrial processes. Second only to security from fire in its influence upon the design was the necessity for cleanliness, dust and smoke being detrimental to a product of high quality. These two considerations, combined with the needs and convenience of operation, determined the general management and principal features of the works. The rules of the Associated Factory Mutual Insurance Companies, of Boston, applying to an "extra-hazardous" risk have been strictly followed.

An accompanying general plan shows the principal horizontal dimensions and the relative locations of the buildings, the minimum distance between buildings being 35 feet, in accordance with insurance requirements. For the reasons mentioned, as well as for convenient access to the railroad for the delivery of coal, the power building was put at the apex of the triangle, or the extreme easterly end of the grounds, the space between it and the next building being 100 feet, and the remaining buildings were arranged so as to put those in which smoke and dust would be most objectionable toward the opposite extremity of the yard. This, fortunately, is also the convenient order for the successive steps in the manufacturing of the processes, and places the chemical buildings with their fumes near the power-house, while the finishing and packing buildings and the office are in the cleaner and safer location. The prevailing winds are from the west, and the length of the lot extends nearly east and west.

To carry the smoke the more surely away from the works the chimney was built several feet higher than the draft requirements demanded. To prevent dust all paths and drives in the yard have coal-tar concrete pavements, and all intervening spaces are grassed; furthermore, the railroad roadbed is to be sprinkled with oil. To avoid tracking mud and dust into the buildings an extensive layout of plank platforms has been built at the main floor level, connecting all the important buildings, as shown on the plan, between which there is likelihood of frequent passing. These platforms have an aggregate length of 2,500 feet and are about 3 to 4 feet above the ground.

Construction.—Eleven of the buildings are of one story, and there are seven of two stories and two of four stories. All have concrete foundations on firm gravel and most of them have basements. The ten principal buildings, namely, the power, acid, mixing, rolling, sheeter, polishing, sheet shipping and novelty buildings, machine shop and the office, are all good-size structures. Their walls are, as a rule, 12 inches thick and pilastered to 16 inches, and their flat roofs are covered with asphalt and gravel composition roofing. Part of the framing of the power, acid and sheeter buildings is of steel, mostly fireproofed in concrete, the steel having been furnished principally by W. S. Smith & Company, of Boston, and the Hawkins Iron Company, of Springfield.

Little difficulty was experienced in finding a



General Plan of the Fiberloid Company's Plant, Springfield.

satisfactory stratum on which to found the buildings, except in the case of the chimney, the site of which, with the chosen location for the power building, most inconveniently proved to be an old eddy hole filled with soft materials. This made it necessary to carry the foundations to a depth of about 20 feet, passing through 13 feet of quicksand; the base of the chimney is of concrete 34 feet in diameter and rests on hard-pan.

The 5,500,000 brick required were supplied by the Standard Brick Company, of Springfield, and, in the building walls, were laid in mortar made of Norton or Hoffman Rosendale cement mixed with lime and the excellent local sand, excepting that the walls of the acid building and the first ten courses above the foundations in the outside walls of the other buildings were laid in 1:4 Portland cement mortar. The sand for the mortar and concrete, as well as a little of the gravel for the concrete, were gotten from a hill nearby, although by far the greater part of the gravel was taken from the excavations for the buildings. It was a coarse river gravel, and the larger stones were crushed at the site. The concrete in foundations, floors and tunnel was made with Alpha and Keystone Portland cement.

To construct so large a plant in less than nine months demanded good facilities and methods and efficient organization. The use of concrete for all foundations is believed to have been a very important factor in saving time. A long temporary spur track was laid into the yard from its easterly end, and, excepting sand and gravel, most of the materials were delivered on cars, as many as twenty-nine cars being switched into the yard every second day during the busiest period. In the main the ordinary standard methods of construction were used, but by attacking the work at many points simultaneously with a large number of men and keeping the various forces moving smoothly, good progress was made. The chimney was built from an inside platform, the brick and mortar being hoisted by means of a small jib crane attached to the outside of the wall and raised at convenient intervals.

Structural Details.—Of the structural details of the plant only a few can be described within the limits of this article. The upper floors are mostly of 3-inch or 4-inch tongued and grooved plank covered with 1-inch maple flooring, and carried on heavy hard pine beams. The chief exceptions are the main floors of the power, acid and sheeter buildings. The floors of the acid building are of reinforced concrete between steel beams 12 and 15 inches in depth, and were constructed by the Atlas Fireproofing Company, of New York. In concrete floors elsewhere and in other places where it is necessary to reinforce the concrete expanded metal was employed.

All basement finished wood floors are laid on tar concrete 4 inches thick, the top dressing 1 inch thick of sand and coal-tar pitch, having been laid just before the floor planks, which were placed before the top dressing became cold and hard. The floors of the heating fan rooms, the blacksmith shop, the three vault buildings, and the fire-pump room are of granolithic concrete 4 inches thick. The coal pocket floor is 1:3:5 Portland cement concrete 4 inches thick. The floors of the engine-room basement, the pump room in the power house, and the boiler room are of hard-burned vitrified bricks set on edge in 3 inches of sand and grouted with Portland cement mortar. Three rooms in the acid building have Neuchatel asphalt surfaces, laid by the Simpson Brothers Company, of Boston, as a watertight finish for the fireproof concrete floors. All toilet rooms have Neuchatel asphalt floors 1 inch thick, turned up 3 inches against the walls.

In the acid building the steelwork is encased in concrete and many precautions were taken in the construction of this building to avoid damage from the fumes. In the sheeter building the floors of 4-inch planks and 1-inch maple top flooring are carried on steel beams. In most cases the heavy machines in the various buildings will be supported on independent foundations, but the lighter machines will be set on the floors.

The composition roofs are covered with special gravel of large size very carefully cleaned, so as to avoid as far as possible the blowing of dust from the roofs. The boiler-house roof has steel trusses 5 feet deep, designed for a load of 60 pounds per square foot, each capable of supporting an 8-ton boiler suspended from any point in its lower chord.

General View of Fiberloid Company's Plant, from the Northeast.

All the buildings, excepting the storehouses and vaults, are well lighted with large windows, and the rolling and sheeter buildings each have large saw-tooth skylights facing north so as to afford additional illumination. The large windows have usually three sashes and the window openings in the walls have arched tops. The bottom sash is arranged to slide up and is furnished with Loxit sash balances, made by the International Lock Company, of Providence; the middle sash is stationary, and the top sash is fitted with mill transom fixtures.

All windows in the sheeter building are double glazed with factory ribbed glass, for the purpose of maintaining a constant temperature. The two dry-houses have double windows with galvanized metal frames, and in all other respects are made as nearly fireproof as practicable, since the danger of ignition is especially imminent here. Most of the other buildings have factory ribbed glass, except in the two lower lights of each sash, which are glazed with clear glass.

Some of the buildings are subdivided by brick fire walls. Door openings through such walls are guarded by double fire doors of wood covered with heavy tin, hung on Coburn Trolley Track Company's sliding fire door fixtures or swinging fixtures, arranged to close automatically by gravity whenever they are opened or held open by fusible links. The three vaults for storing sheets of stock not only have brick walls and granolithic floors, but granolithic roofs also, which are 3 inches thick and reinforced with expanded metal.

Each of the two four-story dry houses has an elevator tower, about 5 feet square inside, in which is installed a hydraulic elevator made by the Springfield Elevator Company. On the side with the tower and on the opposite side of each of these buildings there are three brick air shafts built against the outside walls, like buttresses. These shafts have walls 14 inches thick, with 2-inch air spaces; their flues are 20 inches wide, parallel to the building, while their other dimension decreases from 32 inches successively to 24, 16 and 8 inches, as the inlets to the various stories are passed. These inlets are close to the floor, controlled by dampers.

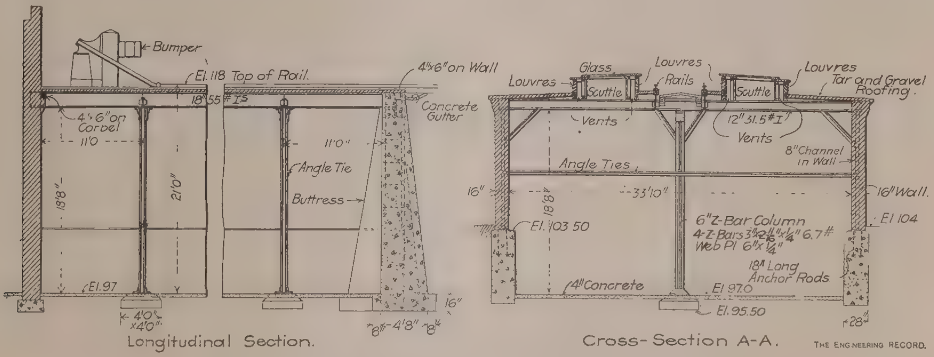
The chimney for the boiler plant is 167 feet high above the top of the foundation, which is 2 feet below the boiler-house floor. Its exterior walls are of red brick 20 inches thick for the first 37 feet, 16 inches thick for 60 feet, and 12 inches thick for the remaining 70 feet, excepting the additional thickness due to the ornamental corbelling at the top. The diameter is 15 feet 8 inches at the bottom and 10 feet at the top under the corbelling, which increases to 10 feet 10 inches. The batters are 5/16 inch per foot for 67 feet from the bottom, 3/16 inch for the next 45 feet, ⅛ inch for 35 feet, and 1/16 inch for the remaining 20 feet, which latter, however, is modified by the corbelling. The proportions are pleasing, as indicated by the view. The inside diameter is 6 feet 4 inches; the walls of the flue are 12 inches thick for 68 feet and 8 inches thick for 86½ feet, extending to within 3½ feet of the top of the outside shell. There are the usual ribs, four in number, projecting from the shell to within 1 inch of the flue wall. The opening for the smoke breeching is 4 feet wide and 6 feet 8 inches high. Provision has been made for an additional connection in the future.

The coal pocket, a part of the power building, is the most easterly structure of the plant, being built against the wall of the boiler house, in the manner shown by the illustrations. The relative elevations of the yard and the railroad are such at this point that a spur track could be laid so as to run on to the top of the coal pocket by building a short embankment and using a maximum rising grade of 5 per cent.

To fit approximately the curve of the spur track, the building has an angle of 163 degrees at its middle, as shown on the plan. The capacity of this pocket is 1,000 tons. Its walls are of brick 16 inches thick, excepting the foundations and the portion of the easterly wall against the embankment, which are of Portland cement concrete, the latter designed as a retaining wall reinforced by two large buttresses on the inside.

The track is carried by 18-inch 55-pound I-beam girders under each rail, supported by 12-inch 31½-pound continuous transverse I-beams, 11 feet apart on centers, extending from wall to wall, with a 6-inch column under the middle of each beam, as shown. The beams are web-connected to the girders with their bottom flanges flush, and their ends are not only built into the walls, but are further supported by 8-inch channels enclosed in the wall. From these channel posts and from the columns there are 4x4-inch angle struts to the bottoms of the beams, and the beams are X-braced in alternate bays by 1-inch and ¾-inch eye-bars. About 6½ feet below their tops the wall posts and the columns are tied together by 4x4-inch horizontal angles. There is thus formed, as will be seen by reference to the drawings, a complete steel trestle.

Coal may be dumped from either hopper-bottom or side-dumping cars. For the former a continuous scuttle with sliding covers between the rails has been provided, and for the latter six separate scuttles, three on each side of the track. The latter scuttles stand about 2½ feet above the roof and have central coal chutes surrounded by enclosing air shafts with louvers in their sides for ventilation. They are glazed with rough plate-glass, thus affording some illumination.



Sections of the Coal Pocket at the Fiberloid Works.

Office Building.—The company's offices are in a one-story attic and basement building of dark-red brick, with gray granite trimmings. The architectural treatment is more elaborate than for the factory buildings, but the details are simple and the appearance is pleasing. The principal windows and doors have semi-circular heads with heavy arches in the brickwork; the walls have bold dentated brick corbelling, surmounted by a copper cornice and gutter. The basement contains heating and ventilating apparatus and affords large storage room. The attic is unfinished, but can be made available wherever needed. A fireproof brick vault 9x9 feet inside has a compartment at the basement-floor level and another at the main floor. The interior of the building is of slightly modified mill construction.

(To be continued.)

A Gas-Producer Power Plant drives the Champagne-sur-Seine works of Messrs. Schneider & Co., near Fontainebleau. There are four 250-h.-p. gas-engine direct-current units. Current is carried by aluminum wires on iron posts.

Mortar Sand.

A paper read before the National Association of Cement Users by Mr. James C. Hain, Engineer of Masonry Construction, C., M. & St. P. Ry.

Can anything new be said about sand? The less experienced know what sand is suitable for mortar, and what is not. The Romans made concrete 2,000 years ago, and were familiar with the requirements of a good sand, one of its important ingredients. Clean, coarse, sharp sand is generally conceded to be the best. With this in view, it is not surprising that apparently little can be said. Although the subject may seem to have been decided thousands of years ago, I still believe there is much to be learned. I can best illustrate my stand by calling your attention to a few sands, with more or less peculiarities, and compare their laboratory tests with a standard.

Allow me briefly to explain the conditions which led to these tests. The Bridge Department of the Chicago, Milwaukee & St. Paul Railway Co., Mr. C. F. Loweth, engineer and superintendent, with whom I am employed in charge of the masonry, requires large quantities of sand in its substructures and culverts, which are principally built of concrete. In the last six years we used a maximum per year of about 85,000 barrels and a minimum of about 50,000 barrels of cement. This will give you an idea of the amount of sand required yearly. The sand comes from numerous sources over the entire system of 7,000 miles, most of which are company sand pits. The problem before us was one of selecting the most suitable sand with the least haul. This led to laboratory tests of questionable sands. In many instances these tests were a great surprise to us. I will call your attention to some of the most peculiar of these.

Before doing so, I will briefly explain the tests. A one to three mixture was used throughout, except where neat cement is specified. Each tensile test represents the average of three briquettes, except in cases where one appeared exceptionally irregular, in which case it was thrown out. The different sands are grouped in the tabulation because each was tested with a different lot of Portland cement, as well as a different sample of the St. Paul standard sand. For these reasons, not only the test in pounds is given, but also the percentage any test is of the corresponding standard test. Thus the percentages give a basis of comparison between the sands of different groups. The neat tests are also shown for comparison. All tests were extended to three years. Those not shown are still to be made.

Calcareous Sand.—One of the early questionable sands which needed our consideration was a bank sand of glacial deposit, found near Elkhart Lake, Wis., tests of which are tabulated. On first observation, its fineness seemed to be the greatest objection. It contained some coarse particles, but the fine ones were in excess. Ninety-two per cent. passed through a No. 24 sieve and 28 per cent. through a No. 50 sieve, while only 54 and 11 per cent., respectively, of the St. Paul standard passed through the same sieves. In other words, on these two sieves Elkhart Lake sand showed up twice as fine as the standard. However, on closer examination, a more striking peculiarity developed, which seemed even more objectionable than its fineness. Apparently the sand bank was a deposit of broken shells, because it could be easily ground into very fine particles by rubbing between two hard objects. When examined under a microscope it appeared to consist of fine grains of silica with rounded, smooth surfaces, mixed with larger particles of softer material with sharper corners, which probably consisted of shells or a soft limestone. (Evidently the silica crystals had been worn round and smooth before the shell-like mixture was added.) While the larger chalk-like particles seemed to be soft, the silica was also easily crushed, but not so readily. When treated with hydrochloric acid it gave off a strong effervescence, indicating that we were probably correct in the supposition that it contained shells or limestone.

We had a particularly important job in the near vicinity where we wanted to use this sand, because this was the only available pit for several hundred miles. Though sand from this pit had been used for building purposes for years, the question arose whether we were safe in using it for the concrete center pier of a draw span. A laboratory test was made in connection with our St. Paul standard sand, for comparison. The results are shown in the table. While the Elkhart Lake sand tests vary from 60 to 99 per cent. of the standard, it averages throughout the tests, up to two years, about 75 per cent. of the standard, which is a very good showing, considering everything. To make the comparison clearer, Ottawa sand, which was favorably recommended by the American Society of Civil Engineers as a desirable standard, developed an average strength of 80 per cent. of our standard, up to two years. From this it appears that the fine shell-like sand from Elkhart Lake differs only by 7 per cent. from the standard sand recommended by the American Society. At all events, we decided to use it for the important job above referred to. The center pier in question was built from it, and the pier stands to-day as an excellent piece of concrete work which has plenty of life and ring.

My opinion of this soft, fine sand has improved. The laboratory tests were much better than I expected. The character of the concrete made from it appeared to be all that could be desired. An excessive haul was saved by using it. On the other hand, I am not in favor of using a sand of this character without first making laboratory tests. All soft, fine sands do not act alike.

Clay in Sand.—Another sand in this same glacial district which was still more of a surprise than the above was the Pound sand, tests of which are platted and tabulated. Its noticeable peculiarity was the presence of foreign material, which resembled clay. The damp sand, when taken from the face of the bank, was plastic, and readily caked in the hand like putty. The particles of silica were held together by the clay. A coating of fine material clung to the hand after handling it. To one accustomed to the usual specifications for a clean sand, free from foreign substances, this would fall far from being satisfactory. Laboratory tests were made, extending to three years. These tests, to our surprise, proved it to be superior in every respect to our standard sand. The seven and twenty-eight-day tests of this were respectively 40 and 30 per cent. above the standard. The difference became less with age, although the three-year test was 20 per cent. above the standard. This surely was contrary to the then general impression of a good sand, especially at the time these tests were started. The sand was found to contain 7.7 per cent. of fine material by decantation, that is, material held in suspension, all of which was perhaps clay. There appeared to be no other peculiarity, and hence it was thought that this clay was beneficial to the sand. At all events, the sand tested so well that it was considered perfectly safe to use it for ordinary concrete purposes. The question of using it under water, where clay might retard setting, was not gone into.

I wish next to call your attention to Eagle No. 1 and No. 2 sands, shown in the diagram and tabulation. The former contained 3.2 per cent. of material held in suspension, while the latter contained 15.7 per cent. Eagle No. 1 was selected for the best sand in the pit, and No. 2 for the poorest. Both sands seemed questionable. Before tests were made, we even doubted the advisability of using any sand from this pit, but decided to order out a shipment of the best (No. 1) for an unimportant job, and follow with tests. The tests proved the unexpected. To our surprise, both tested well, and what was a still greater surprise, the No. 1 Eagle, which contained 3.2 per cent. clay showed up poorer than the No. 2, which contained 15.7 per cent. The particular sample of St. Paul standard sand with which they were compared contained 3.4 per cent. of material held in suspension, largely clay. The strength of all three sands, while irregular, appeared to be governed largely by the amount of material held in suspension, or in other words, the amount of clay. We surely were mistaken in our first estimate of these sands.

Still another test, which proved the superiority of clay in sand in a different way, was the Jackson, Minn., pit sand, one sample of which was washed, and one not. The unwashed showed up about 25 per cent. superior, although it contained 6 per cent. of clay. On the other hand, the washed sand averaged considerably below our standard, about 30 per cent., and the unwashed a trifle below, though very close to it. This comparison to the standard sand is contrary to what we found in the previous sands from the Eagle pit, because the unwashed Jackson sand, which contained 6 per cent. of clay, did not test better than the standard sand which contained only 1 per cent. By looking further, however, and comparing the fineness of the Jackson and standard sand in the tabulation, it will be seen that the standard is a much more desirable mixture of fine and coarse particles, which I believe accounts for the discrepancy and will be touched upon later. This is another example where the presence of clay improved the sand.

Effect of Soil.—The above tests of sands containing clay in their natural state, as well as many others which I have not taken time to mention, tend to prove that the presence of small percentages of clay is not objectionable, but, on the other hand, may be desirable. This, however, does not prove that sand containing ordinary soil is better than one without it. To decide this, we made a series of tests of washed sand to which was artificially added 2, 5, 10 and 20 per cent. of rich surface soil consisting principally of decayed organic matter. The soil was taken from the bank of the Chicago River, where undisturbed weeds had thrived and decomposed season after season, and made the richest kind of soil. The results were disappointing. They were neither decidedly inferior nor superior, but proved quite irregular. The tests up to two years showed that at some period they were above the sand containing no soil, while at others they were below. The percentage of soil added did not cause the tests to follow any definite law. The 20 per cent. adulteration had comparatively little different effect than the 2 per cent. As a whole, the average strength of the tests up to two years was about the same as the clean test, but the irregularity was so great as to make the artificial sands less desirable than the natural.

The diagram will make this clear. It would seem from this that sands with a small admixture of soil ought not be condemned without first making tests, but on the other hand, it is not as desirable as one without soil. Sands of this character, containing soil which consists of decomposed vegetable matter, are rarely found in nature. The soil simply overlies the sand pits, and can be easily stripped off. A rare case of river deposit might occur which contained soil, though this is contrary to expectation, because of the difference in specific gravity of the sand and soil. The two are seldom deposited together. The natural sands are generally found mixed with clay, which consists of decomposed rock.

Prof. C. E. Sherman, of the Ohio State University, has reported laboratory tests up to one year, of Portland cement, with different sands mixed with 0, 2, 4, 6, 8, 10 and 15 per cent. by weight of clay, and also loam. With very few exceptions, the adulterated sand tested superior to the natural sand. In most cases the 10 and 15 per cent. mixtures tested quite uniformly and proved superior by, roughly, 25 per cent. With one exception the clay showed up slightly better than the loam mixtures. His artificial clay-sand tests proved the same as our observations of natural sands containing clay. His artificial loam-sand tested superior to our artificial soil-sand. This latter difference is perhaps due to the difference in character of the material added. He describes the loam as "a common field soil obtained from the field north of the power house on the State University campus." Quite probably, in place of all decomposed material, it contained some clay, and possibly also some sand. This is the only way I can account for the superior comparative showing of the loam tests he made over our comparative soil tests. A small quantity of clay in the loam would change the results.

I will add here that there are two ways in which foreign material occurs in sand banks, one in the form of a fine material, uniformly distributed throughout it, and another in the form of layers or pockets which are entirely distinct from the sand. The cases mentioned, both natural and artificial, were the former. A specification which permits a definite amount of foreign material must, however, exclude all sand in which such material is not uniformly distributed throughout the sand, or, in other words, a part of it.

Fine Sand and Clay.—There are still other peculiar sands to be met with in nature. Your attention is especially called to one other natural sand which seemed to me most striking. It was excavated in Kansas City, on the location of a freight house foundation, which in the flood of 1903 was several feet under water. From appearance and action it was hard to determine whether it contained a larger percentage of sand or clay. What grains it contained were so fine that they were scarcely perceptible to the touch. The quantity of clay seemed large because the trenches stood perpectly vertical under ordinary conditions.

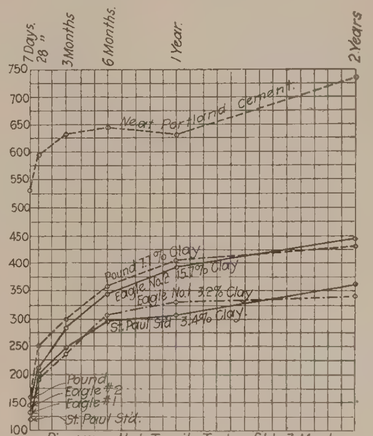


Diagram No.1.-Tensile Tests of 1 to 3 Mortar, with Pit Sand containing Clay. See Group II of Tabulation.

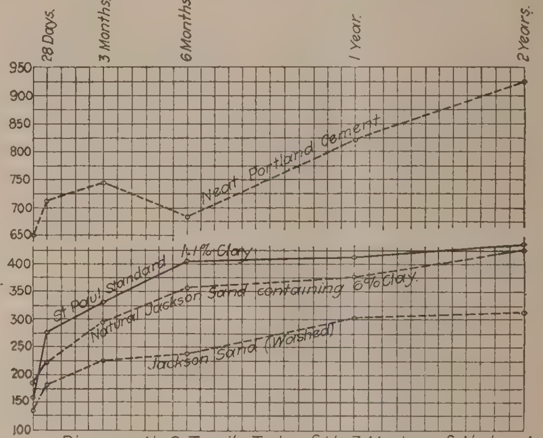


Diagram No.2.-Tensile Tests of 1 to 3 Mortar of Natural Jackson Sand, containing 6% of Clay, and the same Sand, washed. See Group III of Tabulation.

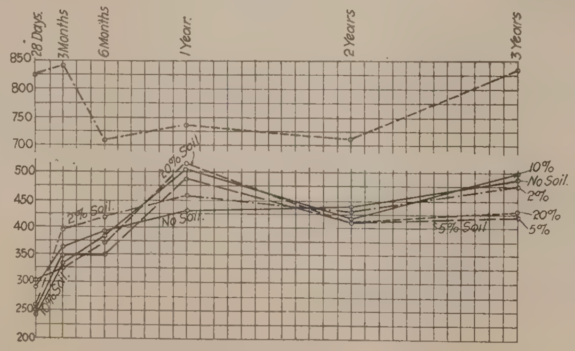


Diagram No.3.-Tensile Tests of 1 to 3 Mortar containing different Percentages of Soil, artifically mixed, with washed St. Paul Standard. See Group IV of Tabulation.

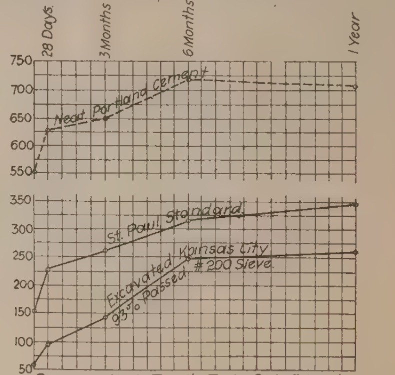


Diagram No.4-Tensile Test of 1 to 3 Mortar made of extremely Fine Sand, compared to St. Paul Standard. See Group V of Tabulation..

THE ENGINEERING RECORD.

Diagrams Showing Effect of Variations in Quality of Mortar Sand.

From the grit, I concluded it was sand, with a rather large percentage of clay. Tests were made of it, and up to date we have the one-year results. It proved to be a very fine sand, which contained about 12 per cent. of material in suspension, largely clay. The most striking peculiarity was its fineness. Everything passed through a No. 100 sieve, and 93.2 per cent. passed a No. 200. In fineness it was far superior to cement. I know of only one cement which is guaranteed 85 per cent. in fineness on a No. 200 sieve. The usual specifications require about 75 per cent. Under an ordinary lens, the grains of this sand were not visible. They appeared to be mostly smooth grains of silica.

The tests proved as interesting as the fineness. The early ones were low. The 7 and 28-day averaged about 35 per cent. of the standard. The three months showed a good gain, while the six months and one year averaged about 77 per cent. of the St. Paul standard, which is about the same showing made by the Ottawa sand recommended as a standard by the American Society of Civil Engineers. The 12 per cent. of foreign material, presumably clay, quite likely helped to improve the tests. I consider that this fine sand shows up remarkably well, in view of the fact that it is finer than the finest cement, and that 93 per cent. passed a No. 200 sieve. It quite likely could be used in massive masonry, were it possible to allow the concrete to set for a year before subjecting it to severe strains.

Effect of Washing.—It will be remembered that the washed Jackson sand tested inferior to the unwashed which contained 6 per cent. of clay. The washing was done according to the laboratory practice decantation. Immersed sand was shaken up in a water bottle, and allowed to settle. The portion held in suspension was poured off. This process was continued until nothing was held in suspension. It will be seen that this method of washing differs widely from the regular practice used at the sand pits. It is my opinion that the Jackson sand would not have tested as well had it been subjected to regular washing in place of the laboratory method. The finer particles of sand would have been carried off with the clay. This would have left larger voids in the sand, and consequently it would not have tested as satisfactorily. Therefore I believe that washing, on general principles, is not desirable unless conditions are unusual. At all events, the sand should be tested washed and unwashed, before going to the expense of fitting up a plant for washing. Unless the sand naturally contains an excess of fine particles, or of foreign substances, I doubt if washing will better it.

Fineness.—A study of the table of fineness will show that the strength of a sand depends to a considerable extent on the proper distribution of the fine and coarse particles. The Ottawa sand, which was favorably recommended by the American Society of Civil Engineers, does not test well, because its fineness is limited between a No. 20 and a No. 30 sieve. It is natural to expect that the absence of small grains leaves larger unfilled voids, and consequently the tests are not as strong. Tests of this sand only averaged about 80 per cent. of the St. Paul standard. I attribute the good showing of our standard largely to the better distribution of the different size particles.

It is difficult to decide what distribution of grains would be most suitable. Please note, however, that the meshes of one sieve are about one-quarter the size of the next larger sieve, and that if there are 40 per cent. of voids in the sand held between two sieves, there ought to be about the same amount of sand held between the next smaller size sieves, or enough to fill these voids, etc. On this assumption I have figured out and tabulated the fineness of a sand that ought to give the best results. A sand might vary from this considerably and yet not alter results materially, because some other distribution of particles might result in as few voids, with only a slight increase in the surfaces to be coated with cement.

By comparing the "excavated" Kansas City sand with the fine "track elevation" sand, both of which are shown in the tabulation, it will be seen that the finer of the two, though it is much finer, and hence has considerably more surface, tested better. This I think is partially accounted for by the undesirable distribution of the particles in the "track elevation" sand. Eighty-three per cent. of the latter sand is held between a No. 50 and a No. 100 sieve, and the percentage of fine particles below this is not enough to fill the voids. However, as stated in the earlier part of this paper, the fine flour-like sand has the advantage of 12 per cent. clay, but this alone, in my judgment, does not account for the difference in showing. I also contribute the low tests of the Rockton sand shown in the tabulation to the same cause. There are not enough fine grains below the No. 50 sieve to fill the voids of larger particles. We have made a great many other tests which tend to prove that this supposition is correct, but which I will not take time to go into.

To sum up the situation, it is quite evident that clay in limited quantities, say not to exceed 12 per cent., is beneficial if thoroughly distributed throughout the sand. Before using, however, it ought to be compared with an established standard.

Soil, on the other hand, is detrimental. Sand containing it shows up irregularly. Such sand should be proved satisfactory by tests before using.

Washed sand may be less desirable than unwashed. Washing removes the fine particles as well as the foreign material. The fine grains, if not in excess, are needed to fill the voids of the larger. The only safe way to decide whether sand ought to be washed would be to test it under both conditions.

A fine sand may show up well if the grains are well graded. A coarse sand may show up poorly if there are too few fine particles to fill the voids. The best graded sand is one in which the grains held on a uniform series of sieves is so arranged that the voids in one lot are filled, and not overfilled, by the grains in the next smaller size, and so on. This grading should begin with large grains in order to limit the surfaces exposed to cement, and still these grains must not be so large that the voids will not be filled with the smaller particles.

Briefly, then, the best mortar sand found in nature is one with sharp corners, rough surfaces, with grains neither coarse, medium nor fine, but with the proper mixture of all these sized particles which will result in the least voids. The sand, also, should not be washed, but may contain up to 12 per cent. of clay, which will not injure, but perhaps improve it.

TENSILE AND FINENESS TESTS OF SAND BY BRIDGE DEPARTMENT; CHICAGO, MILWAUKEE & ST. PAUL RY.

		7 days.		28 days.		3 mos.		6 mos.		1 year.		2 years.		3 years.				Per cent. by weight of sand passing through and held between the following sieves.										
Name of sand and state in which found.	Deposit.*	Tension in in lbs.	Per cent. of standard.	Tension in in lbs.	Per cent. of standard.	Tension in lbs.	Per cent. of standard.	Tension in in lbs.	Per cent. of standard.	Tension in in lbs.	Per cent. of standard.	Tension in in lbs.	Per cent. of standard.	Tension in in lbs.	Per cent. of standard.	Average per cent. of standard.	Pr ct. by decantat'n (in suspension).	Per cent. through No. 8.	Per ct. bet. 8 & 12.	Per cent. through No. 12.	Per ct. bet. 12 & 24.	Per cent. through No. 24.	Per ct. bet. 24 & 50.	Per cent. through No. 50.	Per ct. bet. 50 & 100.	Per cent. through No. 100.	Per ct. bet. 100 & 200.	Per cent. through No. 200.
Group I.																												
Elkhart Lake, Wis.	G.	105	71	174	99	220	69	268	71	258	60	279	82	..	..	73	0.9	100.0	0.5	99.5	7.2	92.3	64.6	27.7	23.5	3.8	2.9	0.9
"St. Paul Standard" Ill.	G.	147	..	176	..	319	..	379	..	433	..	340	..	..	..	..	0.9	100.0	14.9	85.1	31.6	53.5	42.3	11.2	8.7	2.5	1.1	1.4
Neat Portland cement		667	..	699	..	838	..	837	..	757	..	752	..	..	..	..	..	..	..	..	..	..	..	99.3	9.3	90.0	14.5	75.5
Group II.																												
Eagle No. 1, Wis.	G.	128	108	185	97	239	98	302	105	328	108	332	92	382	102	101	3.2	No fineness tests made.										
Eagle No. 2, Wis.	G.	141	118	208	109	278	114	342	119	392	129	442	123	472	126	121	15.7											
Pound, Wis.	G.	166	139	248	130	239	98	302	105	328	108	332	98	382	102	101	3.2											
Rockton, Ill.	G.	116	97	147	77	209	86	241	84	240	79	283	79	..	..	82	2.5	100.0	3.6	96.4	21.4	75.0	55.0	20.0	10.0	10.0	8.0	2.0
"St. Paul Standard," Ill.	G.	119	..	191	..	243	..	288	..	303	..	360	..	373	..	..	3.4	100.0	13.5	86.5	31.7	54.8	41.1	13.7	8.8	4.9	1.2	3.7
Neat Portland cement		533	..	596	..	629	..	646	..	632	..	737	..	744	..	..	..	..	..	..	..	..	..	99.4	8.3	91.1	11.5	79.6
Group III.																												
Jackson (not washed), Minn.	G.	185	116	223	81	290	88	359	88	377	91	428	99	..	..	91	6.0	100.0	10.3	89.7	62.5	27.2	25.0	2.2	1.2	1.0	0.7	0.3
Jackson (washed), Minn.	G.	140	88	181	65	227	69	235	58	303	73	314	72	..	..	69	0.0	100.0	6.3	93.7	49.4	44.3	34.3	10.0	9.2	0.8	0.3	0.5
"St. Paul Standard," Ill.	G.	159	..	277	..	330	..	406	..	413	..	433	..	..	..	..	1.1	100.0	9.2	90.8	34.4	56.4	47.4	9.0	7.7	1.3	0.6	0.7
Neat Portland cement		654	..	710	..	743	..	687	..	818	..	925	..	..	..	..	..	..	..	..	..	..	..	99.6	8.9	90.7	13.9	76.8
Group IV.																												
"St. P. Stand." (washed), Ill.	G.	..	..	292	..	361	..	384	..	430	..	435	..	493	..	..	0.0	100.0	6.3	93.7	49.4	44.3	34.3	10.0	9.2	0.8	0.3	0.5
" " 2% soil "	G.	..	..	257	..	390	..	418	..	458	..	431	..	479	..	..	2.0	Same sand used with exception of soil that was added.										
" " 5% " "	G.	..	..	248	..	348	..	352	..	491	..	414	..	422	..	..	5.0											
" " 10% " "	G.	..	..	242	..	335	..	379	..	506	..	417	..	499	..	..	10.0											
" " 20% " "	G.	..	..	299	..	334	..	368	..	515	..	414	..	431	..	..	20.0											
Neat Portland cement		..	..	825	..	841	..	712	..	735	..	713	..	834	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Group V.																												
Excavated, Kansas City, Mo.	R.	52	34	92	40	141	34	244	77	263	77	..	..	..	..	61	11.9	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	6.8	93.2
Mo. River, Kansas City, Mo.	R.	120	78	174	77	261	100	306	97	312	92	..	..	..	..	91	0.3	100.0	0.0	100.0	2.0	98.0	82.5	15.5	14.0	1.5	0.5	1.0
"St. Paul Standard," Ill.	G.	153	..	227	..	261	..	315	..	340	..	..	..	..	..	..	1.1	100.0	9.2	90.8	34.4	56.4	47.4	9.0	7.7	1.3	0.6	0.7
Neat Portland cement		555	..	627	..	650	..	741	..	712	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	92.5	19.3	73.2
Group VI.																												
Fine track elevation, Ind.	W.	..	..	170	58	201	55	201	52	271	63	243	56	238	59	58	0.3	100.0	0.0	100.0	0.0	100.0	5.7	94.3	83.2	11.1	10.9	0.2
"St. Paul Standard" (washed).	G.	..	..	292	..	361	..	384	..	430	..	435	..	403	..	..	0.0	100.0	8.2	91.8	34.5	57.3	48.5	8.8	8.0	0.8	0.4	0.4
Neat Portland cement		..	..	689	..	667	..	727	..	801	..	604	..	727	..	..	..	..	..	..	..	..	..	..	..	93.7	..	..
Group VII.																												
Possible ideal sand		..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	100.0	60.4	39.6	24.1	15.5	9.6	5.9	3.8	2.1	1.5	0.6

*G—Glacial; R—River; W—Wind.

The International Portland Cement Works at Hull, P. Q., Canada.

By John McClelland Bulkley.

The activity which has been prevalent in almost every line of industry in the Dominion of Canada within the three years past, and especially during 1904, is conclusive evidence that its people are awakening to the splendid possibilities of their country. Its vast area lying to the north and northwest, which has remained practically a sealed book, is to be rapidly opened up and developed by railroads traversing a region whose natural wealth of resources can be but approximately stated at this time. All this is creating a constantly growing demand for structural material of every form, to meet which active preparations are going forward in the erection of new manufactories and the enlargement of existing ones. The employment of Portland cement for building purposes has made rapid strides during the past three years, and in view of the inevitable increased demand for this material in Canada, a limited number of plants of moderate capacity have been erected in the Province of Ontario, but none in the Province of Quebec. During the past year, however, there has been under construction works, now nearly completed, which surpass any hitherto built. They were projected by the International Portland Cement Co., Ltd., composed of prominent citizens of Canada and the United States, with offices at Ottawa and Toronto.

The works of the company are located within the city of Hull, in the Province of Quebec, less than two miles distant from the Dominion Parliament Buildings in Ottawa. The location has many natural advantages and is well suited for the manufacture and shipment of cement. The two raw materials, rock and clay, lie side by side upon the company's property, and the mill is located where they meet, so that the clay is brought into one side and the rock into the other. The rock property consists of 220 acres of a high grade of limestone and the clay property of about 110 acres of clay land. Both materials have been core-bored and tested, proving to be of excellent quality for the production of a high grade of Portland cement. Two lines of railway, the Canadian Pacific and the Ottawa Northern & Western, cross within 100 yd. of the mill. The plant has also the advantage of direct shipment by water, since it is located on the shore of Leamy Lake, from which a Government canal leads to the Gatineau River, almost at its confluence with the Ottawa. From the Ottawa barges reach Montreal and Quebec by means of the Ottawa and St. Lawrence Rivers, while the Rideau Canal affords direct communication with Kingston and other lake ports.

The freight rates on cement from the Western Ontario mills are so high that the eastern portion of Canada has had to depend almost entirely on the European and American cements. The International Company being the farthest east of any of the larger mills, and having such excellent transportation facilities, expects to find a ready and extensive market for its output. Another advantage which this company enjoys is the proximity to abundant water power. The power for the operation of the plant is obtained from the Chaudiere Falls of the Ottawa River, and is transmitted to the factory as three-phase alternating current at 10,000 volts, where step-down transformers reduce the pressure to 600 volts for the operation of induction motors.

The factory itself, which will have a capacity of about 2,000 bbl. per day, comprises twenty buildings and occupies a plot of about eleven acres, the ground actually covered by the buildings being over three acres in extent. The kiln building, the clinker storage, the clinker buildings, the cement warehouse, and the coal drying and grinding buildings are of steel, while the buildings for the preparation of the rock and clay are of wood. The walls of most of the buildings are of hollow cement blocks to a height of about 8 ft., above which they are of cement plaster on expanded metal. The machine shop, blacksmith shop, store room, transformer house, and the chemical laboratory are built entirely of hollow cement blocks; the clay storage, rock storage, air-compressor house, and clinker storage have heavy walls of stone; and the pumping station, situated on low ground near the lake, has walls of monolithic concrete.

The rock quarry will be opened at the south end of the plant, whence the rock is brought to the crushing department by a 1,600-ft. cableway with towers 125 ft. high, the tail tower being movable upon tracks, so that the cable can be swung around to follow up the receding face of the quarry. The rock is dumped from the cableway skips into the hopper of a No. 7½ Gates gyratory crusher and passed through a revolving screen from which tailings more than 1½ in. in size go to a No. 4 Gates crusher and are reduced to a requisite size. It then drops into the bucket of a McCaslin conveyor, which is so arranged that the rock can be carried direct to the dryers or can be dumped into the storage building for use at night or on days when work in the quarry is impracticable. The lower run of this conveyor passes through a tunnel under the storage building, and the rock can be drawn through gates in the top of this tunnel directly into the conveyor, which carries it to the dryers. By this arrangement one conveyor serves to carry the rock from the crushers to the storage, and also to carry it from the storage to the dryers when this is required. The rock dryers, which are 60 ft. in length, are of the revolving cylinder type, and the drying is done by hot air drawn through them by means of exhaust fans placed at the upper end. From the dryers the rock is elevated and carried by a belt conveyor to the feeding hoppers of the ball mills, where it is ground to pass a 20-mesh screen.

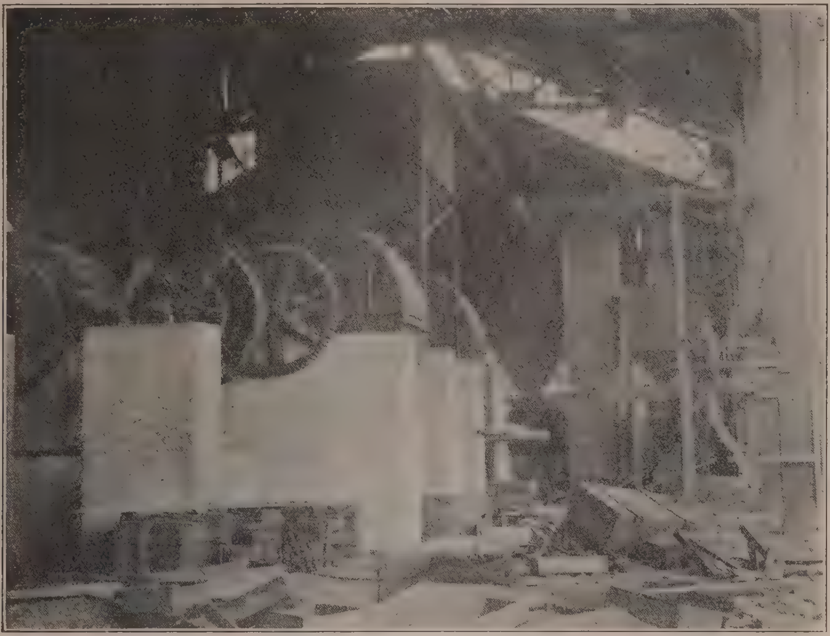
View of International Portland Cement Works from Quarry.

The clay pit will be opened up at the north end of the plant and the clay brought in by a cableway of 1,250 ft. span with towers 80 ft. high. From the cableway buckets it is dumped into a disintegrator, from which it falls upon a belt conveyor, which carries up an incline and discharges it into the top of dryers similar to those for rock. The clay from the dryers is then ground and conveyed to the storage house, which is 68 ft. wide by 200 ft. long, and has a capacity sufficient to carry the plant over five months' run, thus obviating the necessity of bringing in clay during the winter months, when it is difficult to handle and to dry. From the storage building the clay is carried by elevators and conveyors to the mixing department, where it is mixed in proper proportions with the ground rock from the ball mills and deposited in the feeding hoppers of the tube mills. From the tube mills the finely-ground mixture is conveyed to a large steel bin in the top of the kiln building, from which it is fed by adjustable feeders into the rotary kilns.

The kilns, which are 7 ft. in diameter and 60 ft. long, are of especially heavy construction, and the supporting and driving arrangements have been designed to obviate, in so far as possible, any chance of breakdown or stoppage. A line shaft driven by a motor at either end drives the kilns by reduction gears mounted on heavy base-plates. This shaft is so arranged that all kilns can be driven by either motor, or part of them driven by one motor and part by the other. Friction clutches on each drive provide for the starting and stopping of any kiln independently of the others; and change gears, thrown in or out by friction clutches, give the required variations in the speed of rotation of the kilns.

The clinker from the kilns falls into covered pits, whence it runs by gravity into the buckets of a McCaslin conveyor and is carried to the clinker-storage building. This building, which has heavy stone walls strongly buttressed to withstand the pressure of the clinker when full, is 67 ft. wide by 100 ft. long, and has a storage in a tunnel through which passes another conveyor running to the grinding department. The clinker can be drawn from the storage, through chutes in the top of the tunnels, into this conveyor, from which it is discharged into steel hoppers over the ball mills. After passing through the ball mills it is conveyed to the tube mills to the top of the warehouse, where it is discharged into the bins.

The warehouse, which is 80 ft. wide by 210 ft. long, has a storage capacity of about 100,000 bbl. of cement. The roof trusses and supporting columns are of steel, while the bins are of plank laid up in crib fashion, as in grain elevators, and strongly tied together by iron rods. Beneath the center of each row of bins is a tunnel through which runs a conveyor leading to the packing room. The cement in any bin can be drawn through gates in the top of the tunnels, into these conveyors and carried to the packing room, where it is elevated and deposited in overhead bins ready for packing. Two side tracks run upon each side of the packing room, and the cement can be trucked directly to the cars ready for shipment.



Two Ball Mills in Clinker-Grinding Room.

The coal storage, drying and grinding buildings are separate from and at some little distance from the remainder of the plant. The coal, is brought in by rail, will be dumped directly into a large toothed-roll crusher under the track; if brought in by canal boats it will be carried by a system of conveyors to the same point and discharged into the crusher. From this crusher it drops into a bucket conveyor, which deposits it in the storage building. This building is 48 ft. wide and 200 ft. long, and has a storage capacity of 10,000 tons. The construction is of elevator crib work similar to the cement warehouse. From the storage the coal is carried to the dryers, which are similar in construction to those for rock, by a bucket conveyor running through a tunnel under the storage building. A noticeable feature here is the utilization of waste heat from the clinker for drying the coal. An air duct in front of the kilns and connected with the clinker pits leads to the coal dryers. Exhaust fans placed at the upper ends of the dryers draw the hot air from the clinker pits through the dryers, thus affording a safe and economical method of drying the coal. After leaving the dryers the coal is passed through two sets of crushing rolls and is finally reduced to powder by means of tube mills. The powdered coal is carried by a system of elevators and conveyors to steel tanks in front of the kilns, from which it is fed to air-blast injectors and blown into the kilns. The amount of coal dust supplied and the blast of air can both be regulated according to the requirements of the kilns. The air for the injectors is supplied from either of two blowers, each of which has an independent motor drive.

The rock drills in the quarry will be operated by compressed air furnished by an Ingersoll-Sergeant cross-compound compressor, belted to a 150-h.-p. induction motor.

Although the plant is situated within the city of Hull, a complete fire protection system has been installed. Two 700-gal. Worthington turbine pumps direct-connected to induction motors deliver water to an 8-in. main, which supplies a loop line encircling the principal parts of the plant, and having upon it ten Fairbanks hydrants. A branch from the main line supplies water to a 50,000-gal. tank on a 77-ft. tower. For ordinary service only one pump will be used. This pump will fill the tank and supply the regular demand. In case of fire the line leading to the tank will be closed and both pumps operated in series to give high pressure on the mains. The power for operating the pump motors is brought in by an independent line, which is kept at a safe distance from all buildings, so that the service of the pumping plant would not be interfered with by any accident or conflagration in the factory.

Concrete Block Walls for Machine Shop.

The power throughout the plant is supplied by induction motors, of which there are 57, ranging in size from 5 to 150 h.-p. The large number of motors is due to the fact that all machines requiring large power, and some smaller machines, when at a considerable distance from others, are provided with separate motor drives. Only groups of machines which must always be operated together (as a system of elevators and conveyors), are driven from one motor. This arrangement greatly simplifies the distribution of the power and makes possible a much more convenient and economical arrangement of the machinery than would be practicable if the driving were done from a few main lines of heavy shafting. Perhaps the most notable feature of this mill, to one familiar with older type of cement factories, is this convenience of arrangement with reference to the passage of the material through the different processes. The elevating and conveying machinery is thus made comparatively simple, and the materials travel continuously and directly from the raw material departments through the different processes to the cement warehouse.

The structural steel for buildings was furnished and erected by the Brown-Ketcham Iron Works of Indianapolis, Ind., and the cableways by the Flory Manufacturing Co., of Bangor, Pa. Aside from these contracts almost the entire work has been done by the cement company, under the direct supervision of its own engineers, named below, who also prepared all plans and specifications for the plant. The electrical equipment was furnished almost entirely by the Canadian General Electric Co., of Toronto. The elevating and conveying machinery was purchased from the John A. Mead Manufacturing Co., the Link-Belt Engineering Co., the Jeffrey Manufacturing Co., and the Stephens-Adamson Manufacturing Co. The tube mills and rock crushers were manufactured by the Allis-Chalmers Co., and the ball mills by Friedrich Krupp. The kilns and the supporting and driving arrangements for them were furnished by the Bonnot Co. and by the Hill Clutch Co. A view in the clinker room is shown in an accompanying engraving.

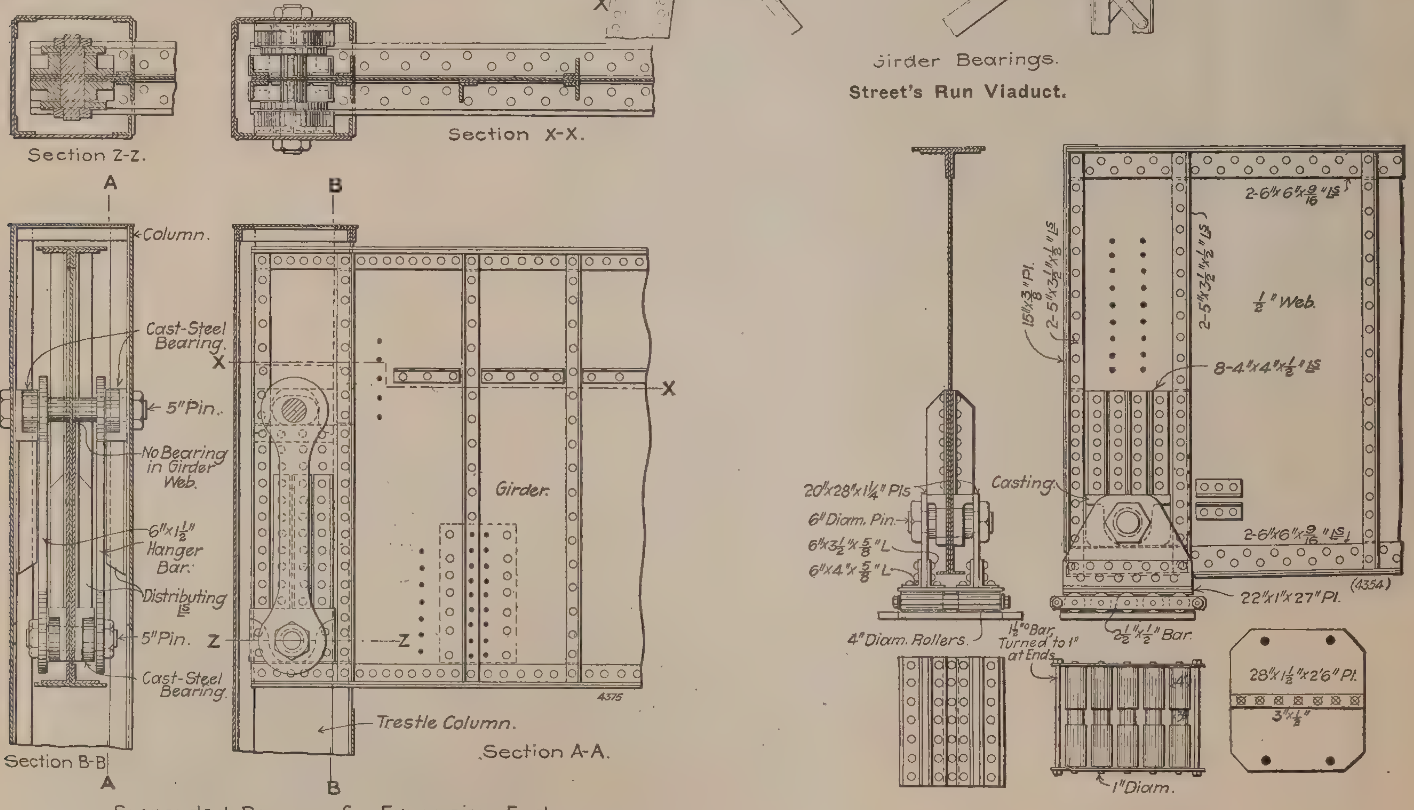
A spacious, well-lighted and ventilated machine shop is not the least of the admirable group of buildings. This is adequately equipped with machinery and machine tools of the latest designs and best manufacture, which, together with the scales. cement testers, etc., were supplied by the Fairbanks Co., through its Montreal branch.

The engineers who prepared the plans and have been throughout in charge of the work are Mr. R. D. Hassan and Mr. A. C. Tagge. Mr. P. W. Stanhope is secretary of the company, and Mr. J. S. Irvin is the managing director.

Types and Details of Bridge Construction: Plate Girders.—XII.

By Frank W. Skinner, C.E.

Miscellaneous End Bearings.—Bridge No. 454 of the West Shore Division of the New York Central & Hudson River R. R. is a through plate-girder span with a center girder 116 ft. long and 7 ft. deep, back to back of angles. It has pin bearings with riveted shoes, pedestals and grillages at both ends, the expansion end differing from the fixed end only by the insertion of a roller nest between the pedestal and the bolster, and by the addition of roller plates and guide ribs above and below the rollers. The triple-web riveted shoe has a planed base-plate field-riveted to the bottom flange of the girder. It is exactly the same width as the flange cover-plate and is concentric with the group of four pairs of vertical web-stiffener angles in the short end panel. The base-plate is planed on both sides and the edges of the web-plates and the bearing surface of their flange connection angles are planed to insure perfect bearing. The webs are peculiar in that each of them has two connection flange angles, and as there is not room for the horizontal flanges of all the angles on the base-plate, those of the center and side webs are superimposed and are riveted, two thick, to the base-plate between the webs. The outer plates of the side webs have full holes and all the other web-plates have half holes for the 5 15/16-in. pin.



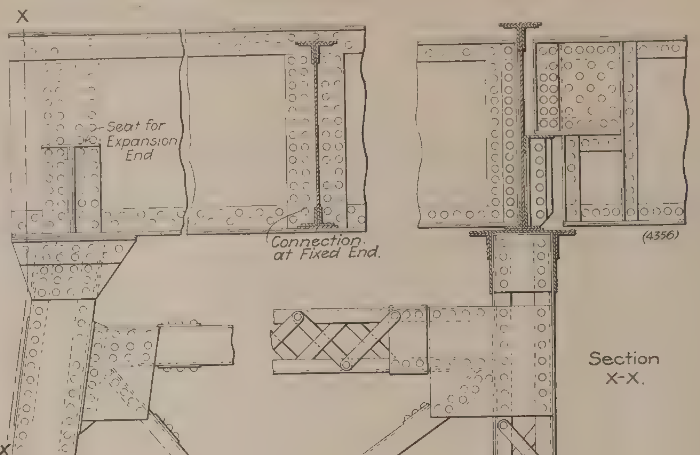
Typical Expansion Bearings for Atlantic Avenue Bridge, Boston.

The pedestal is similar to the shoe reversed, except that it is much wider and longer and the web-connection angles are all riveted directly to the base-plate. The center web is much thicker than that of the shoe, and with the two outside webs provides a combined length of bearing for the pin of 5½ in. The center webs are in the same plane, but have a vertical clearance of ¼ in. each side of the horizontal diameter of the pin, and the outer webs on each side are far enough apart to give clearance for the rivet heads. The base-plate extends about 6 in. beyond the flanges of the web-connection angles to receive the 1½-in. anchor bolts. The pedestal is seated on a bolster 12 in. high, which has the same width and length as its base-plate and is made with seven horizontal I-beams set as close as possible together, transverse to the bridge axis and connected together by top and bottom cover-plates countersunk riveted to their flanges. A sheet of soft lead ¼ in. thick is placed between the grillage and the masonry to secure a uniform distribution of pressure on the latter.

The Cincinnati, Richmond & Muncie R. R. crosses the Whitewater River at Richmond, Ind., on a single-track viaduct 688 ft. long, having one 100-ft. deck plate-girder span and several shorter deck-plate girder spans. The 100-ft. span is 10 ft. deep, with the drop ends beveled to a depth of 72 in. to allow it to be seated at the same level as the shallower girders of the shorter spans. The end panels of the web are reinforced to a total thickness of about 4 in., and have bearings directly on 5-in. pins engaging pedestals like those of an ordinary truss span. The two webs of the shoe are spaced far enough apart to clear the horizontal legs of the lower flange angle without cutting the latter, and the girder web is centrally spaced on the pin by two filler rings. At one end the shoe is seated on a nest of rollers, and at the other end it is bolted to the cap of the tower column.

At the adjacent West Branch Crossing one end of two 60-ft. plate-girder spans is supported on a rocker bent. The ends of the girder abut on the center line of the trestle bent and are riveted together through their end web-stiffener angles. They are seated on an inverted shoe engaging a 3 15/16-in. pin through a pedestal field-riveted to the trestle column cap. In the shoe the most of the pin bearing is on the vertical flanges of the pairs of angles which connect the web-plate to the base-plate. These angles do not have quite full pin-holes, but the plates do have full holes. The ends of the pedestal web-plates are vertical and are connected by transverse vertical plates which enclose the space between the column cap and the girder flange, and exclude most of the dust and moisture which would otherwise collect there.

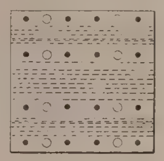
The double-track Streets Run Viaduct of the Pittsburg, Virginia & Charleston R. R. is a very

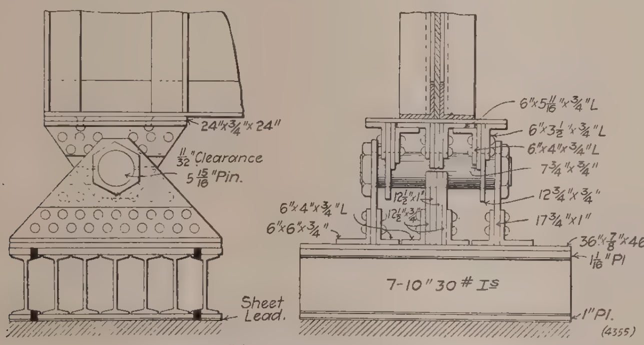


Girder Bearings.

Street's Run Viaduct.

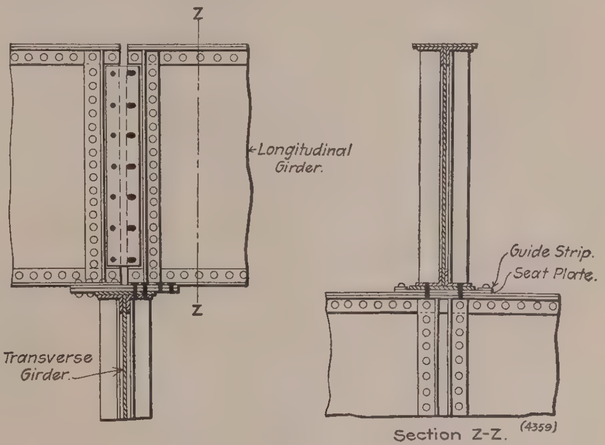
rigid structure with all connections riveted solid. Transverse girders are riveted across the caps of the inclined posts in the towers, and support four lines of longitudinal girders, two lines being on the centers of the batter posts. The fixed ends of the longitudinal girders are field-riveted to reinforcement plates on the girder webs, thus doubling the number of rivet bearings on the webs. Their expansion ends are notched and the webs are reinforced and have bent plate horizontal flanges on the lower edges, which are seated on pedestals riveted to the transverse girder webs. They are secured by vertical bolts in slotted holes, which allow longitudinal motion only and dispense with the necessity for lateral guide plates. The construction is strong and simple and avoids any difficult field riveting or troublesome assembling. In the elevation of the transverse girder both stringer connections should, of course, be alike, but in order to show both fixed and sliding connections, the one over the batter post is shown with an expansion seat and the stringer removed, and the other connection shows a fixed end stringer riveted in place. In the longitudinal elevation the floorbeam is shown in cross-section and the fixed and sliding ends of the stringers meet on it as they do at every expansion joint.





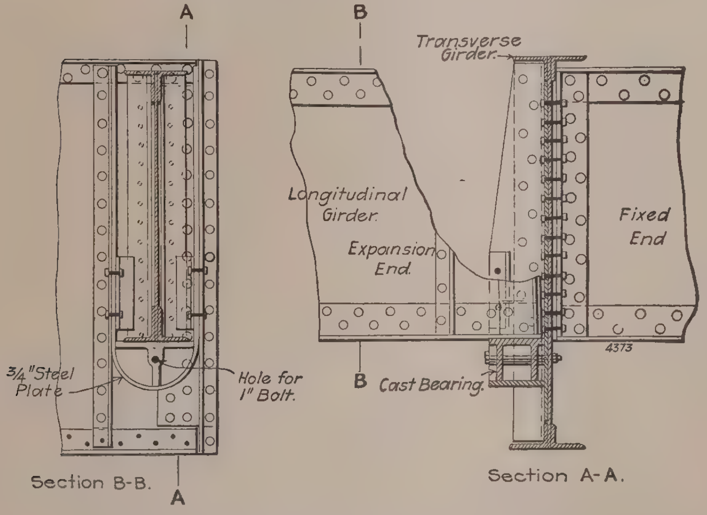
Fixed End Bearing

West Shore Railroad, Bridge No. 454.



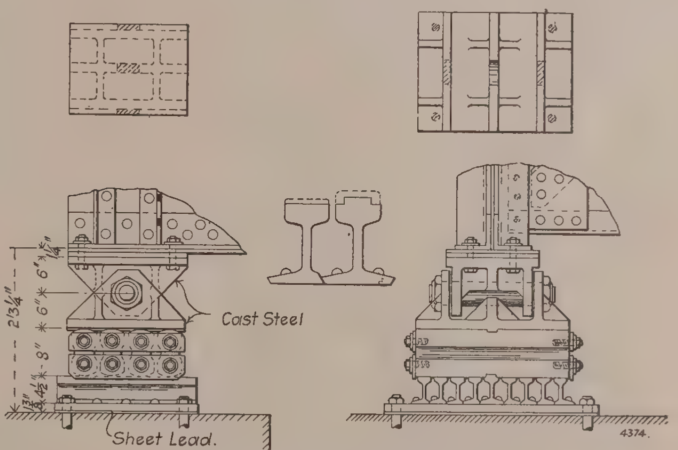
Expansion End Bearing of Girder.

Delaware River Bridge.



Connection for Longitudinal Girders.

Detroit Viaduct.



Standard Roller Bearing.

Chicago, Milwaukee & St. Paul Railroad.

Expansion End Bearings for Railroad Girders.

On the Chicago, Milwaukee & St. Paul Ry. lines girders of less than 70 ft. span have bearings on large cast-iron or cast-steel pedestals of different patterns calculated to insure satisfactory distribution of the load on the masonry. They are made with top and bottom plates and longitudinal and transverse vertical webs, and are anchored to the masonry with four 1½-in. bolts. The tops are planed and the bottoms are planed if not cast true within 1/16 in. The dimensions vary with the spans. Up to 40 ft. they are 8 in. high, and 23x24 in. on the bottom, weighing 425 lb. each. For 45 and 50-ft. spans they are 23x27x10 in. and weigh 570 lb. For 55, 60 and 65-ft. spans they are 25x30x10-in. and weigh 655 lb. At piers they are made like the abutment castings, except that they are much longer and have seats for the girders of the adjacent spans on the same casting. They are 8x21x46 in. and weigh 845 lb. for 30, 35 and 40-ft. spans, and are 10x24x48 in. and weigh 1,125 lb. for 45 and 50-ft. spans. Bolsters for the fixed ends of spans more than 70 ft. are similar to these castings.

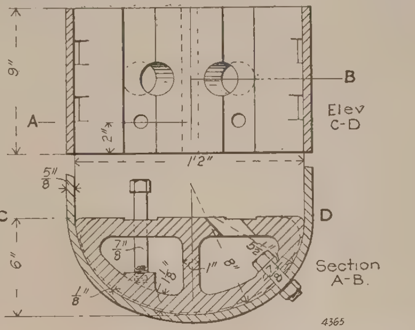
For spans of 70 to 90 ft., triple-web cast-steel shoes are used, which have their webs connected by a pair of transverse diaphragms. The shoes weigh 195 lb. each and engage corresponding 285-lb. pedestals with 4-in. pins. The center webs in shoes and pedestals are in the same plane and have half-hole bearings, the side webs clear each other and have full-hole bearings. At the fixed end the pedestal is seated on a bolster, and at the expansion end on a set of four 8-in. segmental rollers connected to the top and bottom end strips, with gudgeons turned to driving fit. Those in the end rollers have their extremities threaded to receive nuts securing them to the strips; those in the intermediate rollers have shouldered ends flush with the strips. The rollers are seated on a bed made with rails riveted to a 1⅜-in. plate. The lower flanges of the rails have their edges beveled and one of them is cut away nearly to the web. They are thus fitted exactly and ⅝-in. rivets are driven through the wide side of the flange only. A 1 9/16x⅜-in. guide rib is planed in the head of the center rail and the heads of the other rails are planed down 5/16 in. to a uniform height. The center rail is an 85-lb. section 5 3/16 in. high, and the side rails are 75-lb. 4 13/16 in. high. At pier bearings the beds are made 3 ft. 9 in. long to accommodate two spans.

The Fort Point viaduct which carries Atlantic Ave., Boston, over the tracks of the Boston Terminal Co. is composed in part of plate-girder spans. In one of them the three lines of longitudinal girders, about 75 ft. long and 8½ ft. deep over all, are supported at the fixed end by a field-riveted connection through the end web-stiffener angles, and at the expansion end are suspended by vertical eye-bars from the tops of vertical bent columns. Each column is made with a trough-shaped cross-section composed of two built channels and a cover-plate, and has near the top a cast-steel webbed flanged bearing riveted to each web to receive a 5-in. horizontal pin. The horizontal bases of these castings are seated on the milled upper ends of vertical distributing angles riveted to the column and transmitting the loads over an extended length of the column. The pin engages two 6x1½-in. eye-bars 4 ft. long on centers, which at their lower ends take a similar but shorter pin through the lower edge of the girder web. The end of the girder is thus free to swing back and forth inside the column to allow for expansion and contraction, but fits so closely between the bearings that there is little room for transverse motion. The end of the girder web is reinforced with side plates and has a steel bearing casting on each side seated on vertical stiffener angles like those of the column. An 8x10-in. slotted hole on the center of the upper pin gives clearance for the latter to pass through the girder without bearing. This bearing is very sensitive to slight movements, cannot transmit any longitudinal stresses from column to girder, and prevents any danger of being impaired by the accumulation of dirt or rust.

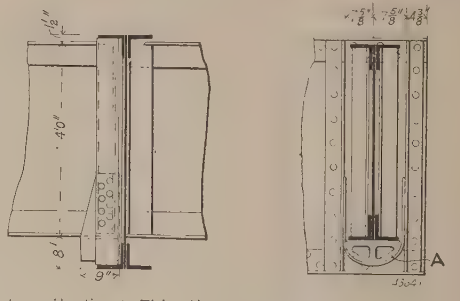
In another span of the same bridge the 71-ft. 9-in. girders are about 7½ ft. deep and have bearings on 6-in. pins through the web near the lower flange 69 ft. 7 in. apart. The web at the pin-point is reinforced, and on each side there is riveted a cast-steel bearing with a horizontal top flange. The flanges engage the milled lower ends of web-stiffener angles which distribute the load over about one-third of the depth of the web. The pedestal is an ordinary double-web riveted one like those usually provided for the end pins of truss spans. It is seated on a nest of rollers grooved in the center to engage the guide strips on the base-plate of the pedestal and on the bed-plate. In this design, although the shoe is nominally dispensed with, the side bearing castings are virtually equivalent to it it, but have the advantage of receiving the load directly from the web where the shear is developed, and avoid subjecting the flange to shear. It also permits the girder to be set several inches lower than it could be with a shoe under the bottom flange.

In the Fordham extension of the Manhattan Elevated Ry., New York, the expansion ends of the longitudinal girders have ½-in. sole-plates riveted to the ends of the bottom flanges and seated on the horizontal upper surfaces of convex castings which fit the U-shaped loops of suspension plates, with their vertical upper ends riveted to the flanges of pairs of vertical web-stiffener angles 15¼ in. apart in the clear. The sole-plates are beveled when necessary to fit the grade, and have slotted holes for vertical stud bolts which secure the girder flanges to the castings. Grooves ⅛ in. deep are made in the surfaces of the castings, so as to define the bearings, and the center of the casting is cored out to lighten it. The casting is secured to the ⅝-in. suspension plate by a pair of radial bolts through the outer shell. The expansion end of one girder is adjacent to the fixed end of the next girder in the same line, and both are supported by the transverse girder. The fixed girder is field-riveted through end flange angles to the web of the transverse girder, and in order to allow clearance for driving the field rivets the end web-stiffener angles on the expansion girder are reversed so that their outstanding flanges are toward the center of the girder, and a second pair of angles is provided near them to receive the sway-brace frame.

(To be continued.)

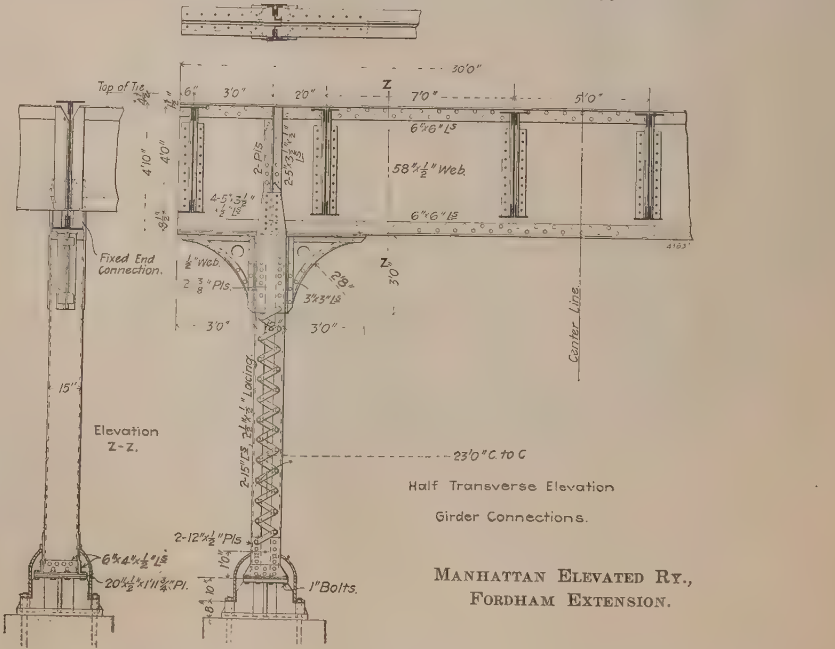


Detail of Bearing Block A.



Longitudinal Elevation. Transverse Elevation.

Fixed and Expansion Supports of Main Girders.



MANHATTAN ELEVATED RY.,
FORDHAM EXTENSION.

Plate-Girder Bridge Construction. Bearings of Ends of Longitudinal Plate-Girders.

THE STEAM BOILERS of the Treforest power house of the South Wales Electrical Power Distribution Co. are of the Niclausse type, each with a rated evaporation of 14,500 lb. per hour. Each boiler is provided with an independent steel chimney 45 ft. high, mounted on the top of the boiler setting. The ashes are raked forward in the ash pit to a chute just inside the doors, and fall into trolleys underneath.

The Water Meter Testing Equipment of the Bureau of Standards.

By Albert S. Merrill, Assistant Physicist.

The Bureau of Standards at Washington has recently moved into the new buildings erected for it in the northwestern section of the District of Columbia, and has been able in its new laboratories to take up considerable new work. One of the new pieces of equipment is an apparatus for testing water meters of the smaller sizes. It was not deemed expedient at present to provide for testing meters larger than those with a 2-in. inlet; however, should a demand arise for testing meters larger than this, an effort would be made to meet it. It should be stated, however, that the present outfit was not installed to relieve any municipality from doing its own testing, but was intended first to furnish a standard of appeal, and, second, to serve as a model of a simple and satisfactory apparatus which any city might copy at small expense.

The laboratory room in which this apparatus has been set up is on the second floor of the Mechanical building of the Bureau, and is about 40 ft. square. It is floored with concrete, pitched to a drain near the side wall, and underlaid with five thicknesses of waterproof paper in order to avoid damage by water leaking into the instrument shop below. The water used is unfiltered Potomac River water from the city mains, and the pressure at this elevation is about 25 lb. The supply main for the building is a 6-in. pipe, and a 2-in. riser from this is carried up to the laboratory through a pipe duct in one of the partitions. A pump in the basement is connected to this line so that higher pressures can be obtained if desired.

Meters which are to be tested are placed in a meter clamping device obtained through Superintendent F. W. Gow, of Medford, Mass. (See Eng. Record, Oct. 8, 1898.) In this machine the bed-plate has been modified so as to form a cylindrical casting with a flanged plate on one end into which the supply pipe is screwed; at the other end a return bend placed vertically terminates in a short piece of pipe over which an adjustable sleeve is fitted. The meter to be tested is set on an iron plate supported by a single screw which enables vertical adjustment to be made to accommodate meters of different sizes. The inlet and outlet nozzles of the meter are thus aligned between the adjustable sleeve and a discharge opening through an upright casting which is bolted to the bed-plate. The sleeve is screwed up against the meter securing it in place and the joints are made tight by using rubber gaskets. For meters smaller than the 2-in. size it is also necessary to insert a pair of reducing connections, four sets of which are provided. The water used in testing is discharged through a multiple delivery cock in which there are twelve orifices ranging from 1/64 to 2 in. The discharged water is weighed in a square steel tank resting on a Fairbanks scale of 5,000 lb. capacity. The tank holds 64 cu. ft. and was made by the Struthers-Wells Co. The waste pipe is flush with the tank bottom and a Chapman lever valve controls the discharge from it.

The meter clamp is set up on the end of a laboratory bench, its base resting in a tray of planished copper 6 ft. long and 2½ ft. wide and surrounded by a ledge ¾ in. high.

A test is made by discharging the water into the weighing tank through a predetermined orifice and the poise on the scale is set ahead a few pounds. The observer then devotes his attention to the meter dial. As the scale beam rises it completes an electrical circuit which lights a lamp beside the meter. Simultaneously the operator starts a stop-watch and notes the meter reading. The pressure is observed on both sides of the meter at frequent intervals and the temperature of the water in the tank is taken. The poise on the scale is then set ahead a certain amount, usually 2,500 lb., and the end of the test is electrically signalled to the observer as at the beginning. This method has proved to be very satisfactory. The electric contact points over the balance beam are made of small carbon blocks to avoid trouble on account of sparking. These terminals are mounted on light springs of brass wire and a piece of vulcanite is attached under the lower one for the balance beam to strike against. The test for leakage, made by determining how large an orifice can be used on the discharge without a meter indication, is considered quite important. Meters are tested at maximum capacity and at one or more intermediate points and duplicate tests are made as a check on all results.

Developments in Heavy Electric Traction.

Just at the present time, the developments in heavy electric traction are attracting more attention than any other subject in the electrical field. A great amount of published information is available for those desirous of studying the history of electric railways, but the present condition of subject, as viewed by those whose labors have developed this situation, is not so easily learned. For this reason attention is drawn to the following abstract of a paper read before the New York Railroad Club on Jan. 20 by Mr. W. B. Potter, of the General Electric Co., which states the opinions held by that corporation on the future of electric railway operation.

The most profitable method of handling a distributed passenger service, Mr. Potter pointed out, is by running many short or long trains as the case may be, at frequent intervals, whereas with steam locomotives it is the general practice to deal with the traffic with only long trains capable of conveying a very large number of people at one time.

This fact shows very forcibly that in a number of instances where the traffic is of a concentrated nature at the present time, and, therefore, considered as unfitted for being handled electrically, were an electric system installed, the traffic would naturally change from the concentrated to the distributed form.

A great deal has been written concerning the possibilities of single-phase traction and, as is often the case with the development of a new principle, many appear to have formed too optimistic ideas of its capabilities. While Mr. Potter recognizes the advantage of such a system in many cases, he believes it is a mistake to imagine that it will be a cure for all ills and revolutionize the railway world. The single-phase A. C. system possesses two features which recommend its use; economy of trolley copper, due to the higher trolley voltages, and the elimination of the rotary converter. The chief advantage gained by these features is a saving in the initial cost of equipment: factors which increase in importance in proportion to the amount of power required by each car or train and with the length of the trolley line. On the other hand, the A. C. car equipments cost more than the D. C. equipments for a similar service and the same given rise in temperature of the motors. It is, therefore, apparent that the relative cost of an A. C. or D. C. system will be materially affected by the number of cars employed.

The saving in power resulting from the elimination of the rotaries is about offset by the greater weight and slightly lower efficiency of the A. C. motor.

The efficiency of the A. C. control, during acceleration, will, generally speaking, be somewhat higher than that of the D. C. system with series parallel control. With the A. C. system fractional voltages can be obtained from the transformer on the car. Each step of the A. C. controller gives a running position which corresponds with the series and parallel positions in a D. C. controller.

The potential of the transmission lines from the power station may be selected, as in the case of the D. C. system, without reference to the trolley or secondary voltage. The trolley voltage must, however, be considered from a different basis than that of the D. C. system for the reason that in addition to the ohmic resistance of the trolley and track circuit, there is an apparent increase in resistance, due to the alternating current. This increase in apparent resistance for 25 cycle alternating current, as compared to direct current, is about 50 per cent. in the trolley wire and between six and seven times greater in the rail return. The rails being steel, the increase in apparent resistance is relatively much greater than in the trolley wire. As the resistance of the track return with large steel rails is proportionately much less than that of the trolley wire, the apparent increase in resistance for the latter and the track taken together will be, roughly, from one-half to twice that for direct current. An alternating current at 1,000 volts, is, therefore, about equivalent to 600 volts direct current so far as affecting the amount of trolley copper, and to secure the advantages of the A. C. system to a reasonable degree at least 3,000 volts or, for heavier service, perhaps 5,000 volts must be employed.

The equipment of heavy locomotives with A. C. motors for high speed passenger service is a possibility, but owing to the limitations imposed by the space available for the motors, it seems probable to Mr. Potter that two locomotives, each with four motors, would be required for service which could be performed by a single D. C. locomotive with four gearless motors. For locomotives in slow speed work, such as freight or shifting, a double gear reduction will, in many cases, be required, owing to the difficulty of winding an A. C. motor of large size for slow speeds.

In view of the extensive application of the D. C. system, it is fortunate that the A. C. motor and its control may be so arranged as to be well adapted for operation on either high potential alternating or 600 volt direct current lines. This adaptability is an important factor in the net earnings as the equipments are not necessarily limited at all times to a particular route and further, where D. C. trolley lines are available, the expense of installing a special A. C. trolley is saved.

The above comparisons relating to A. C. and D. C. systems indicate certain financial and technical differences which have to be met. There is no question as to the successful operation of A. C. apparatus, Mr. Potter says, and the advisability of its use when such an installation will prove financially advantageous.

The power required per ton mile for moving trains varies so greatly with conditions of traffic that any direct comparisons between electricity and steam as a motive power can only be made by assuming a given class of service. The suburban type of traffic is generally recognized as being more especially suited to electrification and a comparison in such service of the steam locomotive and an electrically-equipped train of equal seating capacity was made by Mr. Potter, which may be summarized in the following table:

	Steam.	Electric.
Coal or equivalent electric power...	14.5	10.3
Water	.5	..
Train crew	12.0	6.7
Maintenance	6.5	4.0
Supplies	.5	.2
	34.0	21.2 cts.

Assuming a yearly mileage of 50,000 miles, which is a reasonable assumption for the electric train, the yearly difference in cost of operation, in favor of electricity, would amount to $6,400, representing an interest on the total investment per train which would be more than sufficient for that usually required for the car equipment and the proportionate part of the power station and transmission. Furthermore, to this capitalized investment should be credited the cost of a steam locomotive equipment capable of making 50,000 miles per year. As this is a brief consideration of a general example, it is hardly worth while to enter into refinement, but in nearly every case the use of electric power will make it possible to secure many incidental economies, both in utilization of rolling stock and cost of operation, the aggregate of which may be a large item.

Careful calculations should be made on each individual road considering electrification, as actual results will vary with every new set of conditions. The point at issue is whether the traffic is, or is likely to be, of such a character that the saving in operation or increased receipts will show a proper return upon the required capital.

In considering the application of electric power to freight service, the subject may be considered more strictly from the standpoint of existing traffic, as the reasons which influence the growth of passenger traffic will apply, only in so far as the movement of freight may be facilitated and cheapened. Electric power in a single unit, such as a locomotive, is best suited for general freight, although there may be special cases where it will be advantageous to equip several or all of the cars in a train and control from the leading car.

As with the steam locomotive, the design of the electric locomotive is influenced by the service for which it is to be used.

The bogie truck type following the precedent of the motor car was the first to come into general use and it has become a well-established type for general service in high speed haulage, or for yard shifting where there are many curves.

The articulated type is well represented by the locomotive originally supplied to the B. & O. R. R. for the Baltimore Tunnel. This type is much the same as two coupled locomotives with the disadvantage of not being two independent units, either of which can be operated or repaired independently of the other.

The rigid frame type is one in which all axles are held square with the frame and parallel to one another. The mechanical design is strong and simple and well adapted for heavy slow speed haulage. The additional equipments for the B. & O. tunnel are of this type. Two of these locomotives, with a total weight of 160 tons on the drivers, are ordinarily coupled together and controlled as a single unit.

The requirements of high speed passenger service are especially severe, demanding a locomotive of large power and consequently of heavy weight, as well as one possessing a reasonably flexible wheel base.

The locomotive recently designed and built by the General Electric Company and the American Locomotive Company for the New York Central Railroad is the result of a careful study of many different types. This electric locomotive differs from any that have previously been built, in having a rigid frame for the drivers and pony trucks at each end for guiding.

The method of conveying electric power to a car or train is influenced by the size of equipment and conditions under which it operates. The simple trolley and wheel in general use has been surprisingly satisfactory in service much more severe than that for which the trolley wheel was originally considered. The limitation of its capacity is rather in the life of the wheel than from any particular difficulty in collecting the current. With cars of medium size, at moderate speed, an upward pressure of 15 or 20 lb. against the trolley wire is sufficient and the life of the wheel is frequently 10,000 miles or over. At car speeds of 50 to 60 miles an hour an upward pressure of 35 to 40 lb. appears necessary to insure the wheel maintaining close contact with the wire over the irregularities of the suspension. This greater pressure, coupled with the larger amount of current commonly taken at such speeds, results in the rapid wearing of the trolley wheels, which is more especially noticeable on account of the large daily car mileage, common to high speed service.

Considerable attention is being given to the development of a collector for heavy service which will cost less to maintain than the present trolley wheel. The bow form of trolley, in which a sliding bar of copper or aluminum at right angles to the trolley wire replaces the trolley wheel, has been used to some extent abroad and seems to have met with considrable favor. The cars on which the bow trolley has generally been used are of comparatively slow speed and power, and such tests as have been made indicate that in the equivalent of our suburban service the maintenance of the bow trolley would considerably exceed that of the trolley wheel. A modification of the bow trolley in which a roller replaces the sliding bar has been used in a number of cases, with excellent results. Where the trolley wire is maintained within a foot or two of uniform height, a reversible trolley contact with a pantagraph mechanism, carrying a roller for contact with the wire, can readily be applied. Where the variation in height of the trolley wire is considerable, on different parts of the same line, the pantagraph construction must necessarily be of considerable size. The first electrical equipment of the Brooklyn Bridge was provided with this pantagraph form of trolley, prior to the installation of the third rail. It is customary to install two pantagraph trolleys, each collecting its share of the current and where necessary to collect a larger amount, as might be the case in locomotive work, additional trolley contacts may be installed to any extent required. A pantagraph type of trolley, provided with a shoe, instead of a roller, is well adapted for use in connection with third rail operation, where it is desired to make contact through special track work or road crossings where the third rail cannot be conveniently installed.

The ordinary methods of trolley wire suspension and insulation are not well adapted for high potential alternating trolley lines and what is known as a catenary suspension of the trolley wire will probably be more generally used. In the catenary suspension the supporting cable or catenary is carried over the top of high potential insulators at the point of support and the trolley wire is attached by clips and hangers, directly to the catenary without intervening insulation. The catenary thus serves as a supplemental conductor to the trolley wire and it may be of either steel or copper. As the trolley wire is supported at frequent intervals, the poles for the catenary can be spaced at longer distances than common with the ordinary type of trolley construction. While especially advantageous for high potential work, there is no reason why the catenary form of suspension should not be more generally employed for direct current work and it provides a means for supporting a larger trolley wire, if desired, than is now commonly used.

The third rail, although used to a considerable extent in place of the trolley, has been criticised, particularly from the standpoint of danger and trouble from sleet. The unprotected rail is open to both these objections, but with a suitable protection against accidental contact and from sleet, these objections are to a great extent overcome.

The location of the third rail, with reference to the track, would seem to be a simple question, but owing to local conditions, nearly every installation has been different. Between clearing the low pressure cylinders of compound locomotives, the hoppers on the large steel coal cars and keeping within the bridge abutments and tunnels, the location is generally a case of compromise. It will be advantageous to facilitate the interchange of equipments by establishing a uniform location of the third rail and the importance of such a standard and difficulty of finally determining it will increase with every new installation.

The subdivision of the third rail into sections which will be normally disconnected from the supply circuit and automatically connected when in the immediate vicinity of the car, has many times been proposed. Such an arrangement appears to have little or no advantage, as apart from the complication introduced, the sectional third rail should be protected by a covering to the same degree as an ordinary third rail. Unless the sections are very short, the rail will be energized for some distance beyond the car, and persons getting on or off, or working about the car, would be likely to receive shocks, and more especially so as the rail would ordinarily be considered harmless. Another important reason for protecting the rail is that the cover will form a shield from sleet, which is much more troublesome on a sectional third rail than on the ordinary third rail.

The third rail contact shoe, which has been quite generally used, depends on gravity for its contact with the rail; therefore, at high speeds with any unevenness on surface of the third rail this type of shoe shows a disposition to jump and arc excessively. A better form of shoe is one in which the contact is held against the third rail by a spring, this principal being applied to the hinged type of third rail shoes in use on the Interborough Subway and New York Central locomotive.

The initial expense of electrical equipment, more especially that due to the cost of power station and trolley line, has deterred many steam railroads from electrifying branch lines in sparsely populated districts. Such lines could be served more profitably by independent cars than by steam trains, as the possibility of economically operating single cars on frequent headway, by providing a better service, would have an important influence upon the development of the traffic.

To meet the requirements of this class of service, a self-propelled car, independent of any feeder system, seems particularly well suited. With this end in view there have been numerous schemes suggested and tried, some employing steam and others compressed air as a motive power; and again, storage batteries and gasoline engines have been used. Without discussing the relative merits of these different methods, it may be briefly stated that the gasoline engine seems to have the advantage of possessing the greatest power for a given weight, and is also able to cover considerable distances —owing to the concentrated nature of the fuel and the high efficiency of the engine in relatively small sizes.

A number of such equipments are in operation abroad, some being provided with a mechanical transmission to the wheels similar to an automobile, and others having a generator direct connected to the engine, with the electric motors mounted on the trucks in the usual way. For cars of the weight commonly used on steam railroads in this country, and those which have bogie trucks, the gasoline-electric combination seems in many respects the better suited.

The principal difficulty that has been experienced with this type of equipment is the insufficient capacity of the engine; and this is not surprising when we appreciate that the motors of a 40-ton electric car under ordinary service conditions are frequently required to develop 500 h.p. during acceleration. The building of a successful car of this description is a problem depending entirely upon the engine; and there seems reasonable ground for the belief that an engine well adapted to this class of work can be produced.

The General Electric Co. have under construction an equipment of this character which, if successful, should be well adapted to meet the requirements of the class of service under consideration. This car is provided with passenger, smoking, toilet and baggage compartments and is 65 ft. over all. The engine-room is at one end and a motorman's compartment is provided at each end of the car, to permit its being operated in both directions. The car complete will weigh, approximately, 55 tons.

The engine will have a full load output of 200 brake h.p. and will run at 600 revolutions. It will be direct connected to a 600-volt generator, the fields of which will be separately excited from an exciter driven by the engine. The controller for the motors will be provided with a series parallel switch, but no starting resistance, in the usual sense, will be required, as the speed of the motors will be regulated by controlling the voltage of the generator through field resistance points in the controller. The water-cooling system for the engine will be carried through radiators on the top of the car during the summer, and in the winter through the ordinary heater pipes for the purpose of warming the car. An engine of the size proposed will provide for an acceleration sufficient to maintain a schedule speed of 20 to 25 miles where stops are three to four miles apart and the car can be easily maintained at a running speed of 40 miles, and no data on which we can accurately base the operating cost of such an equipment, but it seems probable that including all expenses—of the motorman, conductor, fuel and maintenance—that the cost will be between 15 to 20 cents per car mile. This will depend somewhat on the daily mileage made by the conductor and motorman, as their wages amount to a considerable portion of the total expense. Reference has been made to this type of equipment, because considerable interest appears to exist regarding the possibilities in this direction, but what measure of success will be attained can only be determined by a thorough trial. Several different types of engines are under consideration, as is also the use of kerosene as a fuel. The object in view is to produce an equipment comparable in some respects to the all-electric car, and at the same time cheaper to operate than the steam trains, which are usually run over the lines for which an equipment of this type is intended.

Performance of Hot-Blast Heating Coils.

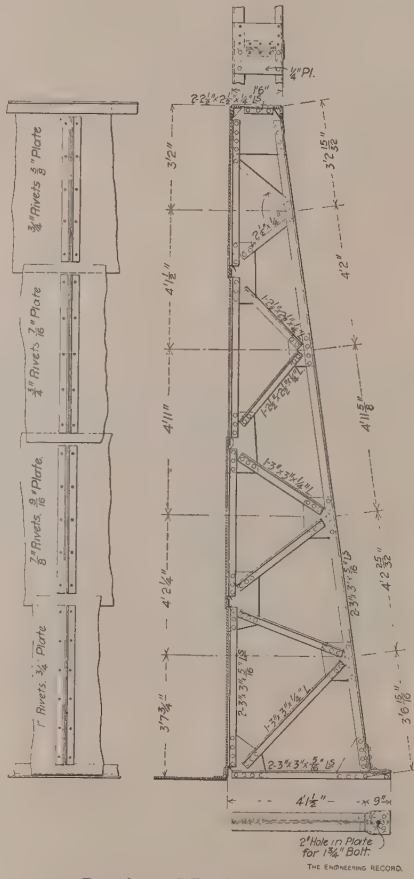
Some data on the condensation in indirect coil heating surface such as is employed in fan-system heating work were contributed at the recent meeting of the American Association for the Advancement of Science by Prof. G. W. Bissell, professor of mechanical engineering at the Iowa State College, Ames. First he referred to tests made by Messrs. Brehl and Byl on the daily performance of the Sturtevant installation in the Engineering Hall of the college, comprising hot-blast apparatus designed to handle 50,000 cu. ft. of air per minute for both heating and ventilation, the only direct radiation in use being that in certain rooms which are used when the major part of the building is unoccupied. The Paul system of vacuum circulation and the Powers system of temperature regulation are in use. According to a chart, forming part of the paper, the average daily condensation appeared to be in direct proportion to the average daily temperature. The equation for the straight line may take the form: Condensation for 24 hours, in cubic feet = 600 — 8.5t, where t is the average temperature for the day.

Condensation in Indirect Steam Heating Coils in Fan Systems.

	Air, cu. ft. per min.	Air pressure.	Coefficients.
One-heater section:			
No. 1.......	4,940	0.6 in.	0.0148
" 2.......	6,510	1.0 "	.0178
" 3.......	7,881	1.5 "	.0201
Two-heater sections:			
No. 4.......	2,646	0.6 "	.0130
" 5.......	3,556	1.0 "	.0156
" 6.......	4,265	1.5 "	.017
Three-heater sections:			
No. 7.......	2,002	0.6 "	.0109
" 8.......	2,620	1.0 "	.0132
" 9.......	3,080	1.5 "	.0146
Four-heater sections:			
No. 10.......	1,472	0.6 "	.0096
" 11.......	2,148	1.0 "	.012
" 12.......	2,681	1.5 "	.0134

The rest of the paper was taken up with a discussion of the results of tests made in the spring of 1904 by Messrs. L. S. Poage and D. C. Thomas on a special hot-blast apparatus designed for determining temperatures, air velocities and condensation under various conditions. As described in a recent issue of the "Iowa Engineer," the air blast was obtained by a 55-in. Sturtevant exhaust fan driven by a 20-h.p. Corliss engine. The air-delivery pipe on approaching the heater was enlarged from 14x24 in. in cross-section to 36¼x43¾ in., in a distance of 4.5 ft. Within the approach were two plane metal deflectors adjusted in position so as to equalize the velocity of the air over the full area. A single heater section was first placed in front of the discharge opening, and in front of this a discharge end was fixed with a rectangular opening of 20x27⅝ in. As the sections were added the discharge end was moved forward. The heater sections were of the miter type, each consisting of four staggered rows of 1-in. pipe, 2⅛ in. on centers, containing approximately 62.5 sq. ft. of effective heating surface. The successively added sections were placed so that the distance from center to center of the sections was about 2 ft. 1 in., leaving a length of duct between sections with arrangements for inserting tubes in the sides of the duct for connecting with the draft gauge.

Tests were made with one section in the duct and with steam pressures of 5, 10, 15, 20 and 25 lb. and air pressures of 0.6, 1 and 1.5 in. Similar tests were made with two, three and four sections in use, but in the three and four-section tests the steam pressures were 5 and 20 lb. The average results are given in the accompanying table, in which the coefficients are the number of pounds of steam that were condensed per square foot of the radiating surface per degree difference in temperature per hour. In compiling this table, Professor Bissell said that advantage was taken of the fact that the data showed that the condensation coefficient was practically independent of the steam pressure within the range of pressures used. He also formulated the conclusion that for a given amount of pipe surface the coefficient varies directly with the air supply, and that for a given initial air pressure the addition of pipe surface by means of additional sections reduces materially and rapidly the capacity of the whole apparatus per unit. Comparison of items 4, 8 and 12 indicate that the coefficient of condensation is independent of the number of rows of pipe where the fan is designed or speeded to deliver a constant quantity of air. The temperature increments corresponding to the addition of sections, with steam at 5 lb. pressure and the quantity of air supply constant, were as follows: Two sections in use, 2,691 cu. ft. air per minute; initial air pressure, 0.6 in.; temperature increment, 42.5°; three sections, 2,631 cu. ft. air; air pressure, 1 in.; temperature increment, 53.9°; four sections, 2,681 cu. ft. air; air pressure, 1.53 in.; temperature increment, 65.5°.



Bracing of Rochester Tank.

THE EFFICIENCIES OF VARIOUS GEARS are as follows, according to Mr. R. Lacau in "L'Eclairage Electrique," although it should be stated that gearing of the proportions and under the conditions of motor-car service is considered. The first figures give the percentage of efficiency for new gearing, and the second for worn gearing. Spur gearing, steel on steel, greased, exposed to street dust, 90 and 80; spur gearing, steel pinion engaging with fibre gear wheel, 88 and 80; spur gearing, leather pinion engaging with cast-iron gear wheel, 88 and 80; spur gearing, steel on steel, oil bath, 92 and 90; bevel gearing, steel on steel, oil bath, 88 and 82; universal joint, 95; roller chain, lubricated and exposed to the air, 94 and 92.

Stiffening a Large Water Tank.

The Rochester & Lake Ontario Water Co. has a large standpipe or tank on a hill overlooking the city of Rochester, as explained in the description of the company's works in this journal on Dec. 24. This tank is 150 ft. in diameter and 20 ft. high, and has been built by Tippett & Wood, of Phillipsburg, N. J. The bottom is built of ⅜-in. wrought-iron plates connected to the lowest course of side plates by a 4x4x¾-in. angle. The side plates are respectively ¾, 9/16, 7/16 and ⅜ in. thick.

This tank is braced by twenty-four vertical trusses connected at the top by a horizontal lattice girder. The inner chord of this girder is a 4x4x½-in. angle, and the other chord is a 3½x2½x¼-in. angle, the girder being 18 in. wide. It has a double system of 1¾x¼-in. lattice bars. This girder prevents the top of the tank from collapsing and transfers the wind load to the vertical trusses. These are designed to act as cantilever beams, the load being applied at the top through the horizontal girder and below that point by means of the shell of the tank, to which the trusses are rigidly riveted. The outer end of each vertical truss is anchored to a masonry pier by a 1¾-in. bolt. The maximum wind pressure considered was 30 lb. per square foot on the convex surface of the tank.

The Compressed Air Power Plants for the Pennsylvania Railroad Tunnels, New York.

Work is well under way on the tunnels under the North and East Rivers by which the Pennsylvania Railroad will enter New York City. The driving of these tunnels is the greatest undertaking in the history of subaqueous tunneling, and compressed air is to play a leading part in the work. The contractors for the air-power equipments were awarded to the Ingersoll-Sergeant Drill Co., of New York, and that company is now installing the machinery which will make up the completed plants. The work is to be carried on in two distinct sections and under two separate contracts.

The larger of the two contracts was that for tunneling under the East River, and was secured by S. Pearson & Son, Inc. It provides for the building of four parallel tubes between Long Island and Manhattan, each to be 33 ft. in diameter. The work is to be pushed from both ends at the same time and the power plant has been subdivided into two sections, one on either side of the river, identical in capacity and character. The plant on the New York side is located at 32d St. and First Ave., and on the Long Island side the main power station is to be found at the foot of Flushing St., Long Island City. At the shaft at East Ave., Long Island City, preliminary work is being carried on with the assistance of a temporary air plant comprising two Ingersoll-Sergeant class A compressors with a combined capacity of 1,200 cu. ft. of free air per minute.

The main air compressing plants on the East River tunnels will together include twelve Ingersoll-Sergeant cross-compound Corliss steam-driven compressors with duplex air ends. Of these, eight are to be low-pressure units, furnishing air at 50 lb. pressure for use in the tunnels for keeping out the water and mud as the shields are driven forward. The low-pressure air is delivered to the tubes by four 10-in. mains on either side of the river. In addition to these low-pressure units there are to be two high-pressure compressors of the same general type, but designed to draw their intake either from the atmosphere or from the discharge of the low-pressure machines. In the former case the capacity of each is 1,500 cu. ft. of free air compressed to 100 lb.; in the second case, it is from 2,000 to 6,600 cu. ft. of free air per minute delivered at pressures up to 150 lb., depending on the intake pressure. This high-pressure air is distributed on the Long Island side through an 8-in. pipe line and on the New York side by a 6-in. main; it is to be used for running rock drills, driving concrete-mixing machines, and possibly for pneumatic haulage. The remaining two units of the system are to be combination compressors having steam cylinders of the same size as the machines above described, but coupled up in tandem to two pairs of duplex high and low-pressure air cylinders 15½ and 22½ in. diameter, respectively. Either set of compressing cylinders may be thrown into operation, and it is thus seen that these combination machines serve the purpose of duplicate or reserve units for either the high or low-pressure compressors.

The compressing plant, as described, is divided equally between the two stations on opposite sides of the river and each portion is served by a battery of five 500-h.-p. water-tube boilers delivering steam at 150 lb. pressure. All these machines are equipped with the Ingersoll-Sergeant positive air-thrown air valves for both intake and discharge. The engineering details of each plant have been carefully worked out and a great flexibility is provided in piping and receiver connections by which any compressor or combination of compressors can be made to furnish air to any tunnel. The work of installation of these plants is progressing rapidly. Boiler and engine foundations are completed, and one of the large Corliss compressors is already in place. The rest are to follow at the rate of one unit per week.

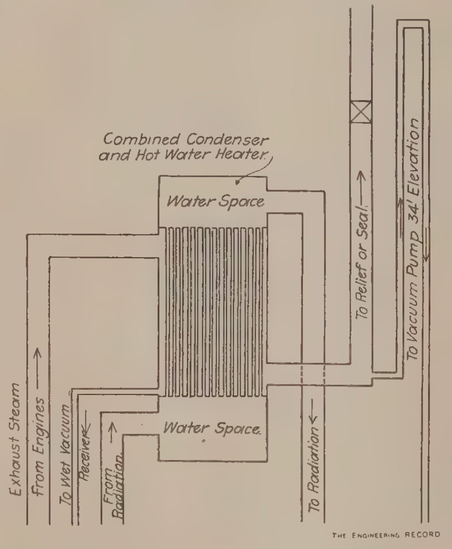
The contract for the North River tunnels is not so extensive as that for the East River, since the plans contemplate only two tubes of a diameter of 33 ft. The O'Rourke Engineering Construction Co., of New York, was awarded this contract, and its machinery also is now being installed by the Ingersoll-Sergeant Drill Co. The air plant for this work has been divided into two sections identical in capacity and type; one located at 32d St. and 11th Ave., New York, the other near Baldwin Ave., in Weehawken. A total of eight compressor units are to be used, four on each side of the river. All are now installed on their foundations. All are of the steam-driven cross-compound Corliss type with duplex air ends. Six are low-pressure machines designed for a terminal pressure of 50 lb. with atmospheric intake, and each have a free-air capacity of 4,000 cu. ft. per minute. There are in addition two high-pressure compressors of the same type, each having a free-air capacity of 920 cu. ft. per minute at a terminal pressure of 100 lb. from atmospheric intake, or 4,000 cu. ft. per minute from 50 lb. intake (from the low-pressure machines), and a terminal pressure of 150 lb. The low-pressure units have the Ingersoll-Sergeant positive air-thrown air inlet and discharge valves; the high-pressure machines have piston inlet valves. Three 400-h.-p. water-tube boilers on each side of the river furnish steam for the compressing plants at 150 lb. pressure. The air is to be used for the same purposes and in the same manner as in the East River tunnels.

MERCURY VAPOR LAMPS have been adopted for lighting the press room of the "New York Times" in its new building at Long Acre Square, New York, where 26 Cooper-Hewitt lamps light four large presses and two autoplate machines included within 17,000 sq. ft. of floor space in a room 21 ft. high. The lamps have tubes 1 in. in diameter and 27¼ in. long, with a light-giving length of 20¾ in.

Opposition to High Buildings in Berlin.

Some time ago the Central Association of German Industrials addressed to the Ministry of the Interior a memorial urging that the present building laws, which do not permit the construction in Berlin of dwellings or business buildings with a greater height from pavement to cornice than 72 ft., be so far relaxed as to allow steel-framed buildings of higher altitude to be erected, if not generally, at least in exceptional cases, when good reason for such variation could be adduced.

The reasons for the proposed innovation, as set forth in the memorial, were that the rapid growth of Berlin in population and business interests required more room to be provided, particularly in the central districts, without increase of cost to tenants; that the restriction to a limit of four stories compelled excessive lateral expansion that had already spread the city over an immense area, and thus lengthened the distance between the homes of many people and their work; and that experience in other countries had shown high steel-framed buildings, when properly constructed, to be safe, comfortable, uniformly better lighted and ventilated, and therefore more sanitary for dwellers and working people than those of ordinary height. Furthermore, it was urged that such a relaxation of building regulations would bring into use great quantities of structural steel and iron which are now largely produced in Germany, and for which an increased market would be highly appreciated by the steel and iron masters, who are making a brave fight for a share in the world's trade.



Condenser for Heating Hot Water.

The appeal of the association was submitted during the summer vacation to the Ministers of Commerce, the Interior, and Public Works, who, after due consideration, made a joint reply, in which the petition was flatly refused, for reasons which were stated at length, but have been condensed by Consul-General F. H. Mason as follows:

(1) The ministries are opposed to any system of building which will lead to an increase in the number of "renting barracks" (Miethscaserne), large buildings divided into a great number of small apartments or tenements, which are leased to families of working people, with the result that a great number of persons of both sexes and all ages are huddled together under conditions which are necessarily subversive of normal family life and prejudicial to public morals.

(2) Buildings so high as to be beyond the level of the present water supply could not be made clean and sanitary.

(3) Any important increase in height beyond the present limit would put the upper stories of the buildings beyond the protection of the fire department, as at present equipped and organized. Whatever might be the material interests involved, the ministries held themselves bound to consider and protect not only the architectural unity and beauty of the city but the health and the moral and physical safety of the people, all of which would, in their opinion, be compromised by the proposed innovation.

With this result the authors of the petition are by no means satisfied, and have replied that they had not proposed to carry buildings in Berlin to the excessive heights which are common in the United States, and that had the desired permission been granted, it would have been provided by careful and competent engineering that all the requirements of fire protection, water supply, and every sanitary necessity should be carefully and completely met.

The discussion stands thus at present, and it does not appear likely that the ministries, fortified as they are by considerations of municipal beauty and public health and safety, will recede from their present position.

Central Hot-Water Heating With Exhaust Steam Under Vacuum.

A central hot-water heating plant to utilize exhaust steam under a vacuum is now being installed in Little Rock, Ark., for the Little Rock Heating Co., by Mr. W. H. Schott, of Chicago. The equipment consists of a Schott surface condenser connected up in the usual way for non-condensing engines except that at the free-air opening of the condenser a vapor pipe is run 34 ft. above the outlet and then led downward to a dry-vacuum pump.

The condensation, instead of gravitating into a tank receiver, is taken through a wet vacuum receiver and delivered into a storage tank for further use. The relief valve in this case becomes both a relief and sealing valve. When desired, as in the case of shutting down the engines or in extreme weather, the water in the system may be heated completely or only partially in the boilers of the plant. If all the heat is imparted to the water, it is necessary in extreme weather to reduce somewhat the vacuum carried to give the proper temperature to the steam. With the temperature at freezing point, 22 in. of vacuum are said to suffice, and the degree of vacuum is increased with increased temperatures of the weather. The arrangement of the piping and values is such that when desired the steam from the engines may readily be exhausted into the atmosphere instead of into the condenser.

TWO PORTABLE ROTARY SUBSTATIONS are to be provided in connection with the conversion of certain steam lines of the Long Island Railroad on Long Island, in addition to five permanent substations which are to serve the system. Each of the portable outfits will consist of a 1,000-kw. rotary converter, with transformers, switches, switchboard and apparatus, all housed in a car of regulation dimensions. They are to accommodate heavy shifting loads, such as are occasioned by the meets at different race tracks, which are not regarded as of sufficient duration to justify permanent investments. The portable rotary stations will be supplied from the Long Island City power station of the Pennsylvania Railroad, now in process of construction as a part of the extensive terminal improvements being developed in the vicinity of New York by that company.

Letters to the Editor.

THE FAILURE OF A MASONRY RAILROAD BRIDGE.

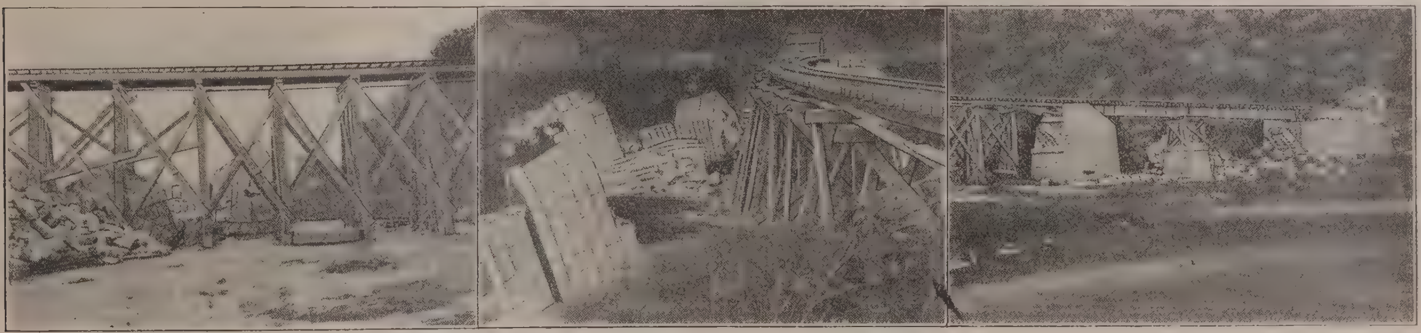
Sir: I enclose three views of a Pennsylvania R. R. bridge that was destroyed when the ice went out of the Susquehanna River last spring. The pictures were taken late in the afternoon, so they are not so clear as could be desired. The conditions when the bridge was destroyed were as follows:

The railroad skirts the river and crosses Conestoga Creek at its mouth. The river was full of ice jams above and possibly there was one below the bridge. As the jams above gave way the ice came down, jammed below and backed the water up. The water at the bridge rose to a height of about 5 ft. above the track, overturning the bridge up into the creek. It is reported that part of the track was carried half a mile up the creek by the rush of the water.

An acquaintance at Conowingo, Md., told me that the flood of water and ice in the Susquehanna reached that place in the afternoon of March 8. At 4 p.m., a gauge showed the river to be at El. 48.1, and by 6 p.m. it had reached a maximum of El. 59.2. The next morning it had fallen to El. 49.5. There was an ice gorge at the mouth of the river which backed the water and ice up into the streets of Port Deposit, 4 miles above.

Yours truly, ENGINEER.

Baltimore, Dec. 21.



VIEW FROM BELOW. VIEW FROM ABOVE. VIEW FROM BELOW.

Views of a Masonry Railroad Bridge over the Susquehanna River Wrecked by Ice.

THE LIFE OF STEEL BRIDGES.

Sir: Your editorial on "Some General Features of Iron and Steel Structural Design" on page 34 of the present volume contains this initial statement: "Experience with the construction and maintenance of iron and steel bridge structures has shown that their average life may reasonably be placed at not more than twenty years, . . . a condition of things which would be considered remarkable had it not already become a matter of every-day observation." In view of the fact that the above partial quotation is liable to be used by those who are now advocating, and "booming" by "up-to-date" methods of advertising, other forms of construction, notably concrete-steel combinations for short span bridges and other structures, in order to influence public opinion unfavorably regarding the durability of steel bridges, it appears to me that this broad and definite statement should not be allowed to go unquestioned by those who are or have been responsible for the design or maintenance of iron or steel bridges.

In this connection it would seem pertinent to inquire upon what statistics, or other information, this statement is based, and if the average life of all iron bridges is only twenty years, what is the maximum and the minimum life of a good iron or steel bridge? It will not be denied that a considerable number of the older types of iron, and some few steel railroad bridges have been replaced by heavier structures in a period of about twenty years from the date when they were built, but has this been done because of actual failure of the bridges replaced, or because these bridges have been examined by engineers and reported unsafe or doubtful for the greatly increased loads that the bridges have had to carry? In this case is it correct to say that the life of the bridge is only twenty years? On this line of reasoning, if a man is examined by a physician for a life insurance company at the age of fifty and rejected as an unsafe risk, his life is only fifty years, although he may actually live to the allotted span of "threescore and ten," and a horse is considered dead because his owner refuses to let him draw double the load which ordinarily tries his strength, although he may continue to draw his usual load for several years more.

In regard to the causes of failure of bridges which have actually dropped under the loads upon them, the communication of Prof. Fletcher in the same issue as your editorial, is important as showing that several of the principal and most conspicuous bridge failures, which have occurred within the last thirty years, have been due to some flaw or defect in construction or to derailment or other accidental occurrence (in which might be included over-loading), bringing an unforeseen strain upon certain members which they were not intended to carry.

To those whose memory goes back forty years, to the days when a large majority of the locomotives in the New England States were wood burners, weighing on the average say twenty tons, and the freight cars fully loaded averaged not over fifteen tons; comparing these loads with modern 100 ton locomotives and 50 ton cars, does it not seem a wonder that more railroad bridges have not broken down?

In the remainder of your article, you bring out clearly and conclusively the fact that a well designed and properly cared for iron or steel structure has "even a greater capacity for durability than most first class masonry structures as they now exist," a statement that is consoling to those responsible for the design and maintenance of good and well cared for iron and steel structures, and which does much to nullify the dispiriting effect of your first statement of the short life of such bridges, nevertheless this statement (and much that follows) stands as a menace to the designers and proprietors of these bridges, and, therefore, may they not pertinently question the extent of its scope and the evidence upon which it is based?

Yours very truly, EDWARD S. SHAW.

Boston, Jan. 16, 1905.

[It is often possible to inject into a single sentence of an article, a meaning that is not intended. In this case, the thought was that the period of usefulness of a metal bridge was generally restricted to about twenty years because the people paying for it refuse to make it strong enough for the traffic which comes on it after its first twenty years' service. That period was mentioned because it is generally accepted among bridge builders as the average life of such a structure; it is doubtful if it is founded on more elaborate data than the contract records of the shops. If the financial interests buying bridges would consent to give iron structures the factor of safety used with masonry there would be no such wholesale removal of bridges as took place on the Lackawanna line some years ago and has been taking place on the West Shore division of the New York Central system recently.]

SAFETY ON RAILROADS.

Sir:—It is with more than usual interest that I have read Mr. Ramsey's letter entitled "Safety on Railroads" (Eng. Record, Jan 7). Few men, if any, possess more extended practical experience in railroad matters than Mr. Ramsey; consequently, whatever he says on the subject should be weighed with the greatest care. He is certainly right in saying that "when a conductor, brakeman and engineer worked under their own rights only, and no other protection, they were more apt to flag properly and take no chances than the trainmen who think they are amply protected by block signals, etc." The same general proposition holds good wherever physical protection or self-preservation is necessary; but the time has passed when communities or transportation companies leave the matter of protection entirely to the individual.

We have in our cities police protection, and on our railroads the protection of visual signals. In both cases these provisions are found necessary for a different order of things from that which existed "when a train crew ran under their own guidance." The existence of these conditions are the result of the accumulated judgment of our predecessors and contemporaries. The detail of construction and operation of the apparatus now most generally approved is the result of the work of the most competent engineers and mechanics this country has produced, but they have thus far failed to furnish all the protection they should. The weakness of the situation lies between their present fullest accomplishment and the actual necessities of the situation; e. g., they have established the conditions complained of in his letter without providing for failures resulting from that human fallibility represented by the act of the man who believes the engineer of the train following should know as much of the conditions surrounding his train as he does, or should be advised of those conditions by the automatic visual signal at the beginning of the block in the rear of his train.

He is right in so many instances that an occasional failure only tends to emphasize the reasonableness of his supposition and prove the claim of signal men that we have fewer collisions under the new order of things than we would have without the safety devices. The real trouble is, he fails to estimate properly the mental or physically abnormal conditions which may govern the following engineer in the interpretation of the automatic signal he is so confidently depending upon. Here again the human element has proved inferior to mechanical accuracy. A visual signal of itself cannot stop a train; it must be seen, understood and obeyed.

To those who fully recognize the great importance of bridging the space between the signal on the post and the "throttle valve" and "air-brake" apparatus on the locomotive, no argument is needed to justify a fair consideration of an addition to the present manually or automatically operated visual systems, of an absolute train-control apparatus the mechanical construction of which conforms to usual railroad practice.

At this point, however, Mr. Ramsey's theory as to the dependence of the engineer thereon takes on new significance, and the writer would hesitate to advocate such a system were it not for the fact that failure properly to observe and obey established signals would be followed by the action of the automatic control apparatus in such a manner as to bring his failure to the attention of the balance of the train crew, and also make a record which should be placed in the hands of the proper official or inspector at the end of each run, and serve as a basis of investigation and deserved reprimand. Under existing conditions, in case of an accident, it is usually possible for the engineer to lay the blame for his mistake upon "the signal" or the "air-brake" system, as there is no record and seldom any observer to contradict his statement. The only objection which can be raised to such a combined method of signaling and train control is its absolute character. It has been characterized by the signal engineer of one of the large roads, who is also a prolific writer on signaling subjects, as impracticable, because absolute obedience to signals cannot be permitted owing to its interference with traffic on a busy line, ignoring the fact that the busier the line the more important absolute obedience to signals becomes to the traveling public. So long as public sentiment permits such signal engineers to retain their positions, so long will appalling catastrophes occur, and the present objection which Mr. Ramsey raises to the increased use of safety devices emphasizes the claim that human ingenuity has reached its limitations in the present exemplification of signaling on steam and electric roads, a view few men would like to publicly express at this time.

Respectfully yours, F. E. Kinsman.
New York, Jan. 21.

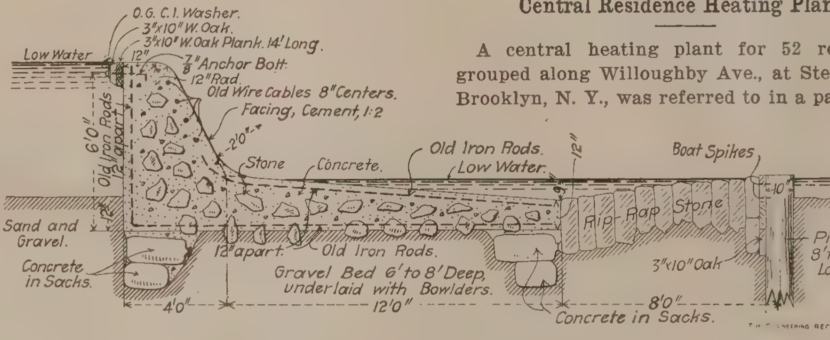
Concrete Dam at Richmond, Ind.

Sir:—In Vol. 50, page 666, of The Engineering Record, is given the cost of a low dam at Manchester, Ia. It states the cost was about $2.50 per cubic yard. There was 1⅓ bbl. of cement used per cubic yard of concrete, and about 1 1/10 yd. of gravel, and at the price given for these two articles the cost would be $2.56 per cubic yard; labor, forms etc. (as per contractor's bid), $2.50, which would make $5.06 per cubic yard. It think it would be well when giving accounts of this kind of work to state the price in terms of cubic yards of masonry in place, and give cost of each class of labor in same unit, something like I have endeavored to do in the following. By doing this it makes the article of value to the engineer, and while not a criterion to go by in other cases, it is a great help, for we all know each individual case presents its own characteristics. Many articles are so incomplete that they are misleading, therefore of little value, and people who read them, not being acquainted with this class of work, are apt to look with suspicion on those who do this kind of work, when they ask from $5 to $8 per cubic yard for the same.

I enclose you a blue print of a low dam I built for the Richmond municipal light and power plant, between the old abutments of the old National bridge over Whitewater River at Richmond, Ind.:

Cost of dam proper, 220 cu. yd. at $5.58	$1,227.60
Cost of reinforcing old abutments and extra foundation, 87 cu. yd.	485.46
Driving 44 16-ft. piles	320.00
Riprap masonry, labor (stone free) 53.5 yd. at $0.80	42.83
Gates for spillways and fish ladder	25.00
Total cost	$2,100.89

The cost of gravel and stone was 80 cents per cubic yard, for each cubic yard of concrete in place; the cost of pumping, 27.5 cents, for each cubic yard of concrete in place; the cost of lumber, 60.8 cents, for each cubic yard of concrete in place; the cost of cement, $1.485 (cement $1.60 per bbl.), for each cubic yard of concrete in place; drift bolts, I-beams and incidentals, 44.5 cents, for each cubic yard of concrete in place; labor, excavating and placing coffer dam, 96 cents, for each cubic yard of concrete in place; concrete and frames, $1.007, for each cubic yard of concrete in place. Total cost, $5.58 per cubic yard.



Cross-Section of Dam at Richmond, Ind.

In excavating is was found that the bed of the stream was entirely composed of, first, sand from 1 to 2 ft., then gravel 2 to 4 ft., then gravel mixed with bowlders and some clay 6 to 8 ft. The sand was a clean washed sand as was the gravel, and was mostly used in the concrete. The sand and gravel was removed around the edges of the dam down to a point where compact gravel was found, upon which concrete was deposited in large sacks containing about 3 cu. ft. each, when in place, filled in and around with concrete. Upon this foundation the dam was constructed as shown by cross-section. Atlas Portland cement was used, one barrel per cubic yard of gravel; the gravel containing the sand. The concrete was mixed what I term wet. Large clean stone were placed upon the sub-grade and wet, the concrete deposited over them to the depth of 6 in., and then another layer of stone placed upon the concrete and settled to place with a rammer.

No stone was nearer to another than 4 in. This operation was repeated until the forms were filled. Around the edges a straight shovel was used to chop the concrete down and work the fine material out next to and the coarse back from the templets. On the face of the dam, facing mixed in a semi-dry state, was placed next to the forms, backed up with concrete and thoroughly tamped as the work progressed. This facing, like the top of dam and top of apron, was mixed one cement and two sand.

It was necessary to build coffer dams around all this work, and to keep a 4-in. centrifugal pump, operated by a steam engine constantly running to keep the water down.

The dam was built in alternate sections of 14 ft. each; the spillway was built first at the east end, provided with two open ways 3x3 ft., then the opposite end. When the last section of 28 ft. was put in, the water in the stream was turned through the open ways which kept the water below the top of the dam, while the last section was being built.

The dam is 120 ft. long, and three tons of old scrap iron rods and cable was used to reinforce it.

The long apron, pile and rip-rap, was built to prevent the high water from washing out in front of the dam. The iron rods was used to reinforce the work, and prevent breaking up of the apron in case a washout would occur. The section of dam is peculiar, and shows what engineers will resort to under existing difficulties that could not be removed but must be overcome. Time will demonstrate the success or failure of this piece of work.

Yours very truly, H. L. Weber,
Richmond, Jan. 14. City Engineer.

Central Residence Heating Plant.

A central heating plant for 52 residences grouped along Willoughby Ave., at Steuben St., Brooklyn, N. Y., was referred to in a paper read by Mr. James A. Donnelly before the American Society of Heating and Ventilating Engineers. These buildings have a total of about 13,000 sq. ft. of radiation, 3,500 sq. ft. of which is indirect. The plant is served from a central steam boiler plant with steam circulated under a vacuum, and 155 automatic pressure motor valves on the drips and returns suffice. The houses with direct radiators are warmed by hot water heated by the steam; 41 of the houses have individual hot-water supply for domestic purposes, heated by the steam; 11 have a large tank for the domestic hot-water supply heated by the vapor of the return, and the remaining house has its entire indirect radiation of 400 sq. ft. heated solely by the return vapor. A similar utilization of the vapor of the returns from a vacuum steam heating system at the Long Island State Hospital at Kings Park, Long Island, was described in these columns Oct. 22 of last year.

The Portland Cement Works of the Societe Casale Monferrato, at Venice, are built on foundations which consist of a level area of armored concrete built around and uniting with the heads of concrete piles. The latter were formed by driving wood piles and then removing them with a twisting action and filling the hole with a lean concrete. In the process of cement manufacture the clay is dried by the gases from the kilns, which are of the rotary type, 72 ft. long and 6.9 ft. in diameter.

CURRENT NEWS SUPPLEMENT

JANUARY 28, 1905.

DIRECTORY OF NATIONAL ENGINEERING SOCIETIES.

American Society of Civil Engineers. Secretary, Chas. Warren Hunt, 220 West 57th St., New York.

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York. Next meeting, Jan. 31, 8:15 P. M., New York; Rear-Admiral Geo. W. Melville, on "Epochs in Marine Engineering."

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York.

American Institute of Mining Engineers. Secretary, R. W. Raymond, 99 John St., New York.

American Institute of Architects. Secretary, Glenn Brown, Washington, D. C.

Association of Engineering Societies. Secretary, John C. Trautwine, Jr., 257 South Fourth St., Philadelphia, Pa.

American Society of Heating and Ventilating Engineers. Secretary, W. M. Mackay, 235 Water St., New York.

Canadian Society of Civil Engineers. Secretary, Clement H. McLeod, 877 Dorchester St., Montreal.

Society for the Promotion of Engineering Education. Secretary, Prof. M. S. Ketchum, University of Colorado, Boulder, Colo.

American Society for Testing Materials. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Municipal Improvements. Secretary, George W. Tillson, Room 12, Municipal Building, Brooklyn, N. Y.

Association of Railway Superintendents of Bridges and Buildings. Secretary, S. F. Paterson, Concord, N. H.

American Railway Engineering and Maintenance of Way Association. Secretary, L. C. Fritch, 1562 Monadnock Block, Chicago.

American Water-Works Association. Secretary, J. M. Diven, Elmira, N. Y.

American Foundrymen's Association. Secretary, Richard Moldenke, P. O. Box 432, New York.

Engine Builders' Association of the United States. Secretary, J. L. Lyle, 39 Cortlandt St., New York.

NATIONAL ASSOCIATION OF CEMENT USERS.

The first annual meeting of the National Association of Cement Users was held in the Claypool Hotel, Indianapolis, Jan. 17 and 18. More than half the States of the Union were represented by over 400 men directly interested in cement products, machinery and materials. A number of rooms of the hotel, as well as a portion of the auditorium on the eighth floor, were given up to the exhibition and practical working of the numerous and varied machines exhibited. Many fine ornamental products were turned out during the convention. The officials claimed that a greater number of machines were shown than were exhibited at the St. Louis Exposition.

John P. Given, of Circleville, Ohio, presided during the sessions and C. C. Brown, of Indianapolis, acted as secretary. A constitution was adopted, and the National Association perfected. Three sessions were held each day, during which papers were read, ample time being given to a spirited discussion of each. A list of these papers was printed on Jan. 14. A question box which was opened at intervals, afforded a medium for the propounding of questions to the several experts present. The exhibition and practical working of the machines attracted much attention. In the report of the committee on the Cement Industry, it was stated that there were in the United States 40,000 cement contractors, 15,000 dealers, and 8,000 architects and engineers who use the cement products. Cement block makers have increased in the last six years from 600 to 1,600. Indiana is credited with four large plants, representing an outlay of $1,450,000. The convention was a great success, over 400 signing the roll of membership. The next convention will be held in Milwaukee. R. L. Humprey, of Philadelphia, was elected president; A. L. Goetzmann, of Chicago, vice-president, and C. C. Brown, Indianapolis, secretary.

THE ANNUAL DINNER OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The preparations for the annual dinner of the American Institute of Electrical Engineers are being pushed actively, and the affair promises to be a great success. It will be devoted, as already announced, to signalizing the triumphs of electric traction. President Lieb has appointed the following committee, which is already at work: Messrs. T. C. Martin, chairman; W. C. Gotshall, L. B. Stillwell, H. G. Stott, Calvin W. Rice, F. C. Bates, H. W. Blake, P. G. Gossler, E. B. Katte, C. W. Price, W. A. Pearson and W. L. Conwell. This committee has organized, and sub-committees are at work on different features of the banquet. Some original and novel features will be included, and it is believed that the oratory will be unusually interesting. Messrs. Frank J. Sprague and Leo Daft are to speak for the Institute pioneers in this great field of electrical development.

The banquet will be held in the grand ballroom of the Waldorf-Astoria on Feb. 8, and it is expected that between 400 and 500 will be present, including many ladies. Tickets are $5 each, exclusive of wine. It may be mentioned that, in addition to the features connected with the dinner itself, there will be exhibited, for the first time, the beautiful oil painting just presented by the British Institution of Electrical Engineers, as a souvenir of last year's visit, to the Institute, representing Dr. Gilbert making magnetic experiments before Queen Elizabeth. The bust of Prof. Ferraris, also presented to the Institute last year, will be exhibited in the Astor Gallery reception room.

The Sullivan mining machine for undercutting coal in room and pillar mines and the method of its operation are described in bulletin 48-B, published by the Sullivan Machinery Co., Railway Exchange, Chicago, Ill.

THE KIESLER AUTOMATIC BUCKET.

A new form of automatic bucket in both orange-peel and clam-shell types has recently been brought out for handling coal, coke, ore, crushed stone, sand and such materials, as well as for excavating purposes. The advantages of the bucket are two-fold, its ability to fill to its full capacity and its freedom from the necessity of being dropped. These advantages are secured by a new design of levers for operating the prongs, which is shown in the accompanying illustrations of an orange-peel bucket of 1½ cu. yd. capacity.

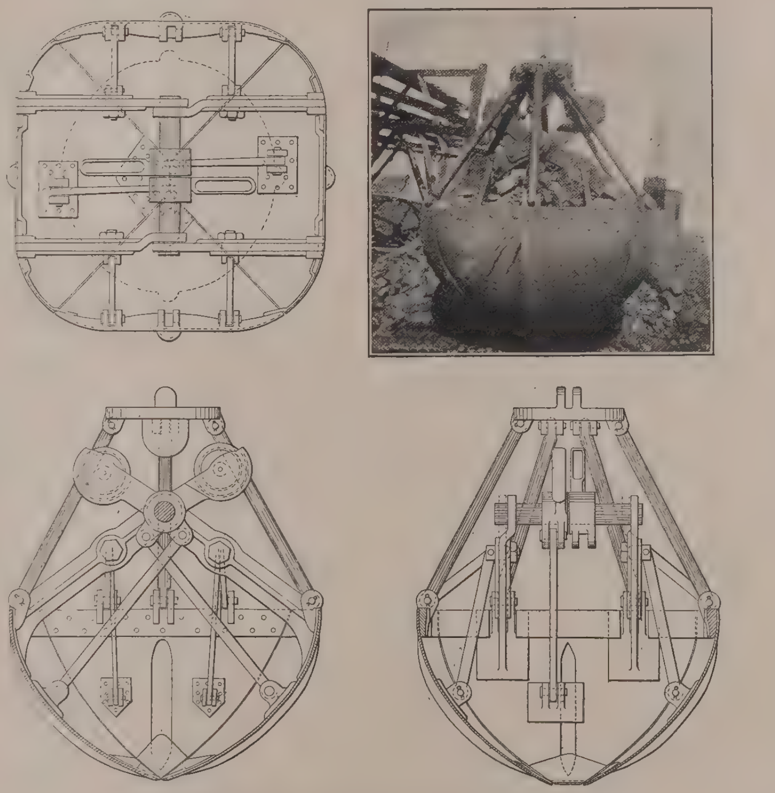
Two of the prongs of this bucket have flat lips at the bottom, and when the bucket is open, they are about a foot lower than the other prongs, which are sharp-pointed. This arrangement is employed to keep the pointed prongs from injuring the boats or cars they are unloading. With dredging buckets the lips are made narrower. The wide-lip prongs are hinged at the top to 2½-in. rods, two to each prong, while one rod is hinged to each of the pointed prongs. These six rods are pinned at the top to a casting, to which the full rope of the bucket is attached.

The operating levers are attached to the prongs well down in the bucket, so as to apply the power with the greatest effectiveness possible. Each prong is operated by a double system of levers, which is arranged not only to open the points, but also to spread out the top edges of the prongs. The action will be apparent from an examination of the points of attachment of the levers and rods. The result of this arrangement is a very wide spreading of the bucket when open, an advantage which the peculiar shape of the prongs utilizes by digging downward when the operating chain is hauled taut. The chain passes around sheaves on the ends of a pair of levers which open and close the prongs somewhat after the fashion of an enormous pair of shears.

Particular attention has been paid to designing the prongs so that they will dig down into the material when the operating chain is hauled taut. This is considered particularly useful in handling soft coal, as it prevents the breakage of the large lumps. The manner in which the bucket will fill itself without assistance is shown in the illustrations.

The buckets can be employed on any hoisting tower, crane or derrick using a two-line hoist, without any change in the machinery. They can also be used on a one-line hoist by the addition of an idler drum and a counterweight.

These buckets are called the "Kiesler," and have recently been placed on the market by Mayo & Bailey, National Bank Bldg., Chicago. The clam-shell type has the same system of leverage as the orange-peel.



THE KIESLER AUTOMATIC ORANGE-PEEL BUCKET.

MEETING OF THE AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS.

The eleventh annual meeting of the American Society of Heating and Ventilating Engineers was held last week in New York at the Hotel Astor. The first session, on the afternoon of Jan. 17, was devoted to business matters. The address of the president, Mr. Andrew Harvey, of Detroit, and the reports of the secretary, of the treasurer, and of the board of governors showed that the society had made material progress. The membership was increased by 24 additions to full membership, 4 to associate membership, and 2 to the junior grade, and the treasury was said to be in the best condition it has been since the society's foundation. Mr. B. H. Carpenter, of Wilkesbarre, Pa., as a member of the committee on compulsory legislation, referred to the enactment of an act governing school-house ventilation in New York State. Mr. A. A. Cary, of New York City, called attention to the fact that an agreement had been made among the national societies of mechanical, mining, civil and electrical engineers on a series of abbreviations of technical terms and recommended its adoption by the society; the matter was referred to the committee on standards. A cablegram was read transmitting greetings of the British Institution of Heating and Ventilating Engineers. The election of officers, as announced in the evening session, was reported among the personal notes last week.

The second session, in the evening, was opened by the reading of a paper on "Appliances and Results in Exhaust Steam Circulation," by Mr. James A. Donnelly, of New York. He gave figures for a number of vacuum circulation steam-heating plants equipped with the differential pressure controlling valves and the so-called impulse valves invented by him. These appliances were illustrated in these pages in the "Current News Supplement" of Nov. 5, and one of the installations referred to in the paper, that at the Kings Park, Long Island, State Hospital, where the domestic hot-water supply is warmed by the vapor arising from the returns, was described briefly in The Engineering Record of Oct. 22. The present paper, however, gave some additional figures concerning the impulse valve. The small opening between disk and seat for the withdrawal of air and the first flow of water is, it appears, the equivalent of a 3/32-in. round hole, and removes the air in 10 min. with ¼-lb pressure differential. When the water reaches the valve, the opening, if increased to ¾ in., its full area, would remove the initial condensation in 2 min. Tests have shown, he said, that the valve is opened to an effective area of about one-half this amount, and passes the water in 4 min. He calculated that as a 3/32-in. hole with ¼-lb. differential will pass 36 lb. of water per hour, if the flow of the water were regular the impulse valve would not again open after the normal rate of condensation was established. These figures, it may be said, are apparently based on 100 sq. ft. of radiation condensing 30 lb. of steam in an hour. In practical operation, the flow being irregular, the valve does operate, and as its capacity at its maximum is sufficient to keep the radiator drained by being open 6 min. to the hour, it may be nine-tenths of the time passing steam. This would give, he said, a flow of 1 lb. of steam per hour, and would require about 3½ sq. ft. of heating surface upon the return to condense it. In addition to this surface upon the return, if it is also required to cool down the 30 lb. of water to the temperature of

15 in. of vacuum (180°), 6 sq. ft. of radiation is necessary.

The paper elicited considerable discussion, which with topical discussions occupied the remainder of the evening. On the topic of tunnel ventilation, Mr. Cary explained at length the scheme he had recommended in 1901 for the relief of the New York Central Railroad tunnel in New York when the subject was prominently before the public, and when the present scheme of operating the trains electrically was not determined on.

The first session of the second day was held on the afternoon of Jan. 18, when papers were read by Prof. R. C. Carpenter, on an investigation of the accuracy of direct-reading hygrometers; by Mr. R. S. Thompson, of Springfield, O., on gas as a fuel for hot-air heating, and by Mr. R. P. Bolton, of New York, on steam-heating in connection with condensing engines. Prof. Carpenter gave the results of experiments made on two hygrometers of the direct-reading type that could be bought for $2 each, and found that the errors were not great for ordinary conditions of temperature and moisture, and would serve a useful purpose in the household. One read too low by an amount which averaged nearly 2 deg., while the other read too high by about 5 deg. It will be of interest to add that, in using it in his house, he found that the humidity ranged from 18 to 35 per cent., averaging perhaps 25 per cent., while the humidity out of doors was 60 to 70 per cent. He called attention to the fact that the present day tables of the moisture-carrying capacity of air with varying temperatures are quite different from those in existence ten years ago, owing to the investigations of recent years. In reply to an inquiry, he estimated that the humidity outside averaged 70 per cent. during winter months, at least in the region of Ithaca, and somewhat less during summer months. Prof. William Kent expressed the belief that dryness of the air was desirable for comfort at extreme temperatures, both high and low. Mr. J. J. Blackmore, manager of the heating department of the J. L. Mott Iron Works, felt that while some years ago too much attention was paid to provisions for moistening and to water pans, now there was too little.

Mr. Thompson's paper discussed in part the disposal of the water of condensation resulting from the combustion of the gas, his analysis being, in brief, as follows: A thousand cubic feet of gas weighs about 37 lb., and if of high quality contains from 9 to 11 lb. of hydrogen, but as each pound of hydrogen in the gas combines during combustion with 8 lb. of oxygen from the air, there is a production of 9 lb. of water for each pound of hydrogen contained in the gas, and 1,000 cu. ft. of good gas will produce from 80 to 100 lb. of water when burned. A large portion of this water can be mechanically carried off through the chimney in the form of mist which is suspended in the air after the latent heat has been removed, but some of it will, under some conditions, form into drops and run down the inside of the chimney. Every chimney used for a gas fire should be straight and lined with tile, as the water of condensation is corrosive, owing to the presence of sulphur in natural gas. He said that to use gas economically a sufficient amount of surface must be exposed to the products of combustion to reduce their temperature below 212° and effect the condensation of the moisture formed. With regard to proportions, he said that there should be about 1 sq. ft. of furnace-heating surface for each cubic foot of gas burned per hour. A statement made by the author that if more air is mixed with the gas than required, combustion will be imperfect, and part of the gas will be unburned was questioned, but Prof. Carpenter explained that natural gas is difficult to burn without smoke, as there is a tendency for the hydrogen to burn first and the carbon to pass off in flecks. He thought that the danger of excess of air was just this and not, as intimated by the author, the production of carbon monoxide.

Mr. Bolton's paper, some figures of which are given in an abstract among the leading articles of last week, was explained as a suggestion looking toward the supply of heating apparatus with steam under a vacuum; the system being placed between the engine and the condenser. Prof. Kent thought such a system of some promise, and the heating surface might be amply large, of the proportions of hot-water surface, for example. Mr. Juan Almirall, of Evans, Almirall & Co., felt that an unusually well-installed piping system would be required, in order to get a satisfactory degree of vacuum at the engine with the relatively great number of fittings and valves with their liability to leakage of air, and that a large-size condenser would probably be necessary. Mr. Bolton thought these objections were in part met by the fact that the heating surface acts itself to a greater or less degree as a condenser.

The rest of the session was taken up largely with a discussion on grate and heating surface in furnace heating. Mr. C. E. Oldacre, of Philadelphia, after numerous figures had been advanced, held that the furnace having the largest proportion of prime heating surface to grate surface was the most efficient, and that a ratio of 40 to 60 sq. ft. of heating surface to 1 sq. ft. of grate area applied equally well to the steam and hot-water boiler or the hot-air furnace. Finally a committee, composed of Prof. Kent, Mr. Frank K. Chew and Mr. Oldacre, was appointed to compile data obtainable in the available literature on the subject. The professional session was adjourned after an extended discussion, opened by Mr. Cary, on the requirements of heating boilers using bituminous coal, and the evening was given over to the annual dinner of the Society, now the established chief social function of the convention.

The next session of the meeting was held on the morning of Jan. 19, when papers were presented by Capt. A. B. Reck, of Copenhagen, Denmark, on an experience with radiators in the top story of a building, and by Mr. John S. Brennan, of the A. J. Lindemann & Hoversen Co., of Milwaukee, on the circulation of hot water. Captain Reck's paper brought on a discussion regarding measures for preventing drafts from skylights. There seemed to be a predominance of opinion that direct coils to offset downdrafts from such glass surface were unnecessary, as the effect could be obtained by a proper distribution of the room-heating apparatus, whether direct or indirect. One instance of a large dome was mentioned where no special means whatever has been found necessary, and Mr. H. J. Barron, of New York, said that he had found that the heating surface provided for skylights was frequently not in operation. Considerable discussion also arose on the question of providing in top stories for the heat losses through ceilings, and Mr. Wm. G. Snow, of Francis Bros. & Jellett, Inc., of Philadelphia, stated that a rule he had found satisfactory was to regard 1 sq. ft. of ceiling which was unprotected by an attic space as equivalent to 20 sq. ft. of glass surface and ceilings that vere so protected as equivalent to 10 sq. ft. of glass surface.

In the next paper, Mr. John S. Brennan gave the results of a test for water temperatures with a radiator having the ordinary connections and with a radiator having the Brennan circulating valve described in these columns in the "Current News Supplement" of Aug. 13, 1904. The first-mentioned radiator was a 13-loop, 38-in. high Corinth radiator, containing 71.5 sq. ft. of radiating surface, and the other was a 24-loop, 14-in. Unique radiator having 96 sq. ft. of radiating surface. The circulating valve amounts to a single connection to the radiator with an internal partition and to one side of it is brought the supply pipe and from the other is taken the return pipe; the partition is continued so as to cause the inflowing water to pass upward within one end of the radiator to the top before it can descend through the remaining sections of the radiator. Over a range of temperature of 98° to 213° in the hot-water supply to the radiator with the special valve, the temperature drop in the radiator varied from 6° to 10° or 12°, and was 4° to 6° greater than occurred in the radiator with ordinary connections.

In the discussion it was suggested that the connections to the radiator having the ordinary arrangements were large in size and this fact might explain in part for the temperature conditions, while Mr. Mackay described experiments made some years ago which indicated that it was better to allow the water to reach the upper portion of the radiator through several columns when it would descend through the remainder and set up a satisfactory circulation.

The afternoon session was opened with the reading by Prof. Carpenter of an interesting resumé of early works on heating and ventilation, which afforded an opportunity to contrast present practice with that of fifty years ago. Then there were no standard or manufactured forms of heaters or radiating surface, and it was necessary for the heating engineer to also be his own manufacturer and designer, and construct his own heaters, radiators, etc. In practically all the examples cited in Tredgold's book, cast-iron pipes are shown. He gives preference to the flanged joints packed with a flat plat of slightly twisted hemp yarn which had been previously saturated with stiff white lead paint. For the purpose of taking up expansion, he recommends that a drum of thin copper be employed, which may be compressed or extended without injury. He was well acquainted with the design and construction and use of steam traps for removing the water of condensation.

The cast-iron boiler, shown in Tredgold's work, is of spherical form, without internal tubes, and it is set in a brick casing so arranged as to cause the heated gases to encircle the sphere in a spiral path. The wrought-iron boiler is of cylindrical form, without any internal flues and is set in brickwork so as to be encircled by the heated gases. The boiler is provided with a safety valve opening inward to prevent the formation of a vacuum and a combined manhole cover and safety valve opening outwards, the manhole cover being held on by a bar designed to give way should any excess of pressure come upon the boiler.

In 1844, Dr. D. B. Reid wrote a work on the "Theory and Practice of Ventilation," which is a classic in its line, even to the present day. He described a number of forms of fans or blowers which indicates that in many cases these were frequently used at that time for forcing in fresh air from the outside, or exhausting it from the inside. The blowers, or, as Dr. Reid calls them, "fanners," while well known, were evidently not used to any great extent at his time, probably principally because of the difficulty of obtaining power.

The works of Peclet were printed in France about the same time as the books previously referred to. Professor Carpenter thinks it will be generally admitted that all our processes of heating were known in a general way fifty or sixty years ago, that our improvements have been principally in the line of details of manufacture, in adapting materials to a greater field of usefulness, and in working up standards for manufactured articles. The vacuum systems of heating were not, however, described fifty years ago.

The remainder of the session was devoted mainly to the discussion of various topics, but the committee on tests reported the result of trials of a steam-heating boiler which exhibited as good an economy as obtained with power boilers. Stove size of anthracite coal was used, and a steam pressure of 4 lb. by gauge maintained. The heating surface was 155.5 sq. ft., and the ratio of heating to grate surface was 25 to 1. Coal was burned at the rate of 3.8 lb. and 5.2 lb. per square foot of grate. An equivalent evaporation, from and at 212°, of 10.25 lb. of water, per pound of coal was obtained and of 10.48 lb. per pound of combustible. The flue temperature varied between 300° and 350°. In concluding the report of this convention, it must be said that the sessions were unusually well attended, on the whole, and a livelier interest was manifested in the topics and papers than in some former meetings.

ANNUAL MEETING OF THE ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.

The annual meeting of the Illinois Society of Engineers and Surveyors was held at the Sherman House in Chicago, Jan. 18, 19 and 20. The meeting was the most successful one in the history of the society. Not only was the attendance greater than at previous assemblages, but the papers as presented covered in an interesting manner a wide range of subjects. The first session of the convention was called to order at half-past two o'clock Wednesday afternoon by Mr. S. S. Greeley, of Chicago, who delivered the address of welcome.

President J. W. Alvord, in his address which followed, gave a few facts concerning the history of the society. The first meeting was held at Champaign, Ill., February 23, 1886, at which forty members were present. In 1888, at the meeting held at Springfield, the attendance was increased to seventy. Up to the present time 366 papers had been presented. These had all been of a high rank. The purpose of the society, he said, was to teach the isolated engineer that he is a member of a profession, and that for what he gives out to others he receives one hundredfold. The engineer is to-day appreciated more than ever before. The work of the society was not at its highest level until the waterworks engineer, sanitary engineers, and others were brought into it.

The several papers, which followed President Alvord's address, dealt particularly with the drainage of land in Illinois and Iowa. The first of these was presented by Mr. J. J. Melluish on "Drainage in Western Iowa." He said the draining of land in Iowa had received a great impetus by the drainage law of 1903. One district was mentioned where the annual loss due to improper drainage was more than $20,000,000 per year. Capitalized at 5 per cent., this would warrant an expenditure of $405,000,000. The cost of providing proper drainage at $25 per acre would be only $101,000,000.

"How Tile Drainage Improves the Soil," was the subject of the next paper. In the absence of the author, Mr. A. D. Alexander, of Decatur, Ill., the paper was read by Secretary Edward Ernest Russell Tratman. After eighteen years of experience Mr. Alexander said he was convinced that underdrainage was far better than surface drainage. With surface drainage fertilizer thrown upon the surface was often carried away without being absorbed. When underdrainage is used, the fertilizers are compelled to pass through the earth before reaching the drains. With underdrainage the frost is out of the ground earlier, the soil is more open and porous, and the air is given better access to the ground.

The report of the Committee on Drainage was read by Mr. C. G. Elliot. This was concerned largely with the drainage conditions in Illinois. The prominent features in the last few years had been the straightening and deepening of existing streams. There were, however, drainage districts organized in Green and Henry counties which would involve an expenditure of $500,000.

The subject of drainage having been opened for discussion Mr. Bell described the first large drainage ditch in Illinois. This had been dug in Mason county more than twenty years ago. It had been given no attention until this year, when the willows growing in the bottom had been cleaned out.

Mr. Chase, of Clinton county, Iowa, said that Iowa engineers had trouble getting their pay for drainage work, and that they object to the requirement compelling them to give bond.

At the close of the discussion the paper by Mr. F. Oswald on "School House Construction" was read. Buildings with a capacity of more than 800, he said, should be built entirely of fireproof material. The very small ones might be constructed of wood. The floors should be constructed for a live load of 80 pounds per square foot. In the plans great import should be given to the lighting and ventilation and to the comfort and safety of the scholars. Stairways should be not more than four feet wide so that only two files could pass down them. The height of steps in primary schools should be seven inches. The windows should be double glazed, as this saved 30 per cent. of the heat lost through single-glazed windows. The amount of glass surface should be one-sixth the area of the floor.

At the conclusion of Mr. Oswald's paper, President Alvord took occasion to announce that twenty-seven new names had been presented for membership to the society. He also called attention to the exhibits of drawing apparatus, surveyors' instruments, and engineering materials which were arranged in a neighboring room. The meeting was then adjourned until 7 o'clock.

The evening session was called at 7.15 o'clock. President Alvord opened the meeting by reading a letter from Mr. George W. Jackson, chief engineer and general manager of the Illinois Telephone Construction Co., which stated that, because of lack of time, the writer had found it impossible to either prepare the paper that had been assigned to him or to be present at the meeting. The company which he represented would, however, have trains in readiness at 8.30 o'clock in the evening to convey the members of the association through the tunnels on an inspection tour.

A paper, "The Park System of Chicago," prepared by Mr. A. C. Schrader, was then read by the author. The city system of parks, he said, was inadequate to its needs. The system at present consisted of about 6 square miles. Realizing the need of more parks, the city had selected twelve new sites for parks. These varied from about 5 acres in extent to 322 acres, giving total acreage of 627.24. The present park system was outlined in 1869. The chief glory of Chicago, he said, was in her lake front. This had been largely spoiled by the occupation of the railways. But the park now under construction by filling in the lake beyond the railway tracks would give much-needed recreation space.

Mr. Nelson, in the discussion which folwed the reading of the paper, spoke of the vement on foot to secure the few sites of tural beauty surrounding the city for an ter belt of parks. The land, he said, ould be secured now while it is cheap.

Mr. Harmon, of Peoria, stated that his y, realizing the future need of parks, had cently purchased three tracts of land each 0 acres in extent. Two of these had been proved, and were much apreciated by the ople of the city.

The paper by Mr. F. L. Hancock on "Street ving at Quincy, Ill.," was read by Secre- ry Tratman, Mr. Hancock not being pres- t. Quincy has 34 miles of paved streets. e first was laid with double course brick, t most of the work is of single course con- ruction. Mr. Hancock believed that in all ses a concrete base was cheapest.

It had been previously arranged to make n inspection trip into the tunnels of the linois Telephone Construction Company at e adjournment of the meeting. That the embers might better appreciate the trip, ecretary Tratman made a few remarks con- rning the tunnels under all of the down- wn streets of Chicago and their construc- on. These are about 30 miles in extent, 10 iles of which are laid with a track of 24- . gauge. They are 26 ft. below the streets, eing 6 ft. wide and 7½ ft. high.

The session Thursday morning was called t 9.30 o'clock. Prof. A. N. Talbot, J. J. elluish and Mr. Hale, of Dekalb, were ap- ointed a committee to investigate and get efore the legislature the subjects of geologi- al surveys, good roads, and license of sur- eyors in Illinois. The committee was given he power to appoint sub-committees of from hree to five members on each of the three ubjects. Mr. W. S. Shields was afterwards ppointed as a fourth member of the legis- ative committee, being assigned to the sub- ect of special assessments.

President Alvord also appointed as a nom- nating committee Mr. Paddock, of Moline; r. W. S. Shields, of Chicago, and Mr. Har- on of Peoria.

The regular programme was then opened y Mr. S. S. Greeley, who presented a paper, History of Surveying in Chicago." He re- iewed some incidents connected with early urveying around Chicago. On one occasion is party captured a full-grown prairie wolf n what is now the city limits of Chicago. he vast increase in the value of lands in ertain portions of the city increased the ecessity of the greatest accuracy possible in urveying. This accuracy could be better ob- ained if some standards of length were avail- ble in Chicago. A law passed several years go gave to the county clerk the right to rocure standards of weights and measures, ut did not compel him to do so. They had ever been obtained in Cook county. A move- ent is at the present time on foot to estab- ish a standard bench length 100 ft. long, robably to be located on the lake front.

After the fire of 1871, he said, professional ivalry was suspended, and all civil engineers oined in restoring of lost corners and bound- ry lines. Within fifteen days after this fire, ffices were established and the work of re- racing lines was in progress. The official ecords, maps and plates had been destroyed, ut the copies of the records of two private rms enabled relocation to be made with very ttle contention.

"Modern City Surveying in Chicago" was e subject of a paper by Mr. S. N. Howard, hich was read by the secretary. The un- erground piping systems, he said, have de- royed all the original section lines in Chi- go. Rights to property depend considerably occupation. This, if continued for a length time, establishes identity.

The paper of Mr. W. H. Hedges on "Bench arks" proved most interesting. In the fall 1897 the city officials ordered the estab- shment of fifty standard bench monuments. ese were made 6 feet high, being 42 inches uare at the bottom and 16 inches at the p. In the center of the top a rod of metal ft. long and ½ in. in diameter was in- rted, and upon this the point of reference as established. In 1898 the establishment thirty-two more was ordered. All of these ere placed about one mile apart, and as arly as possible at the corners of sections, ey were usually placed in the grass plot tween the pavement and the curb line. In tting them the precise level system was t adopted, the exact method being used be- use of the lessened expense.

In reply to the question as to whether any them had changed their positions since be- g placed, Mr. Hedges stated that one on chigan Ave. had been reported to have settled two or three one-hundredths of an inch. This bench mark was located in "made land." He had not yet verified the report.

Mr. W. D. Jones read a paper on "Judicial Elements in Surveying." Surveying, he said, amounted to something more than running straight lines. In the absence of definite controlling points, the surveyor was often called upon to conduct a code case of his own in the location of property lines. If he did not consider all the facts present, or considers them wrongly, the courts were likely to reverse his decision. The theory that the value of property should govern the care of the survey often proved a scapegoat, but it must be remembered that the survey must not be made to cost more than the land is worth.

A general description of the course in surveying at the University of Illinois was given by Mr. L. A. Waterbury in a paper entitled, "Instruction in Surveying at the University of Illinois."

Five semester hours each week are devoted to this work during the sophomore year and half of the junior year. For field work surveying parties are made up of eight or nine students.

For office work they are assigned portions of land upon which to investigate the title. That the local county recorder shall not be bothered too much, this work is given to the students just before vacation, and on lands in their resident county.

Surveying standards of length and elevation had been established at the university; standard of length consists of two copper bolts embedded in concrete posts 100 ft. apart. For the standard of elevation a steel bolt had been placed in the capstone at the entrance of University Hall, being at an elevation of 720 ft. above sea level.

Mr. H. H. Bremer, in his paper entitled "The Surveyor," said that a surveyor was neither a professional man nor a laborer, but had a particular field of his own. Often the duties of judge, jury, lawyer, and witness were forced upon him.

The report of the Committee on Surveying, which followed, called attention to the government monuments, and favored the maintenance of government corners. It stated that federal government is publishing maps of large areas of Illinois. These maps contained no section lines, and the committee thought they should be shown. Attention was called to the various datum planes in use. The committee thought some fixed level should be adopted.

At the conclusion of the discussion of the previous papers the meeting was adjourned until evening, the afternoon being set aside for an inspection trip to the Buffington cement plant of the Illinois Steel Company.

The evening session was called to order by President Alvord at 7.45 o'clock. The first paper presented was that of D. W. Mead, entitled "Filtration Plants," and was illustrated by means of lantern slides. The filter systems now in use in this country and in Europe were described. The establishment of a good filter system, Mr. Mead stated, would not assure a pure water supply. It is necessary to have it properly operated. While a first-class operator could often get good results from an inferior system, a poor operator could not get results from a properly installed plant. He called attention to the fact that the water may sometimes remain too long in the coagulating basins. In the case of the plant at Moline, Ill., it was observed that when the filter was run at a very slow rate, good results were not obtained. Upon using only one of the two coagulating basins better water resulted. This was accounted for by the fact that with two basins in operation, the passage of the water through them was so slow that the coagulant dropped before the water was put through the sand, and the benefits of the film found upon the sand were not obtained.

Mr. C. B. Burdick gave some results of tests on water meters in a paper entitled, "Accuracy Tests of Water Meters at Des Moines, Ia." In all there were 1,064 meters tested, some of which had been in service twelve years. Tests were made by running water through them, weighing the water and considering 62.5 pounds of water to a cubic foot.

The average of the test on the smaller meters gave an accuracy of 99 per cent. on a ⅛-in. stream. When the meters registered from 91 to 92½ per cent. they were speeded up by changing the gear ratio. With those not varying more than 2½ per cent. below normal, it was usually necessary to merely clean the gears. Of the total number tested 512 were replaced without alteration, 471 were repaired in the test room of the company, 15 were repaired in a local machine shop, and 66 were returned to the factory.

"The Inlet Swamp Drainage District" was the subject of a paper by Mr. A. M. Shaw. This described the system of ditches draining a district in Illinois embracing a total of 57 square miles. The total cost was $197,000, and the work of excavating averaged 7 cents per cubic yard. The average cost per acre was $6.

The report of the executive board having been called for, Mr. Melluish stated that Jan. 17 there was a balance in the treasury of $287.87. This balance, he stated, was due to the efforts of Secretary Tratman in cutting down the current expenses, and in obtaining advertisements for the published reports of the proceedings of the meetings. The committee reported that 35 names had been added to the membership roll, and that since the last meeting, the society had been incorporated under the laws of the State of Illinois.

The nominating committee reported D. H. Maury, of Peoria, for president; J. G. Melluish, of Bloomington, for vice-president, and J. W. Alvord, of Chicago, and F. Oswold, of Alhambra, for trustees. The secretary was instructed to cast the unanimous vote of the society for those nominated.

Invitations were extended to the society by representatives of Monmouth, Peoria and Rockford, to hold its next meeting in these cities. Rockford was chosen. The meeting then adjourned.

The meeting on Friday morning was begun at 9.45 o'clock, the first paper read being that of D. H. Maury, entitled, "New Well and Hydraulic Pumping Plant at Peoria, Ill." The paper was largely concerned with the sinking of a steel strainer well. This was 21½ ft. long and 9 ft. in outside diameter. It contained 34,000 punched holes 11/16 in. in diameter, and was sunk in gravel by weighting it with 40 tons of pig iron and then excavating underneath it. It was necessary in sinking it the last sixteen feet, to employ air pressure to keep the water out of the excavation.

The paper by Mr. W. B. Ewing described the sewage and drainage system of Wheaton, Ill. In the system a septic tank measuring 66x132 ft. is employed. Trench cutting machines were largely used in excavating for the pipes.

The report of the Committee on Sewage and Drainage called attention to work being done in Chicago in the Calumet and Jackson Park districts.

Mr. McClanahan, in discussing the subject of sewage disposal, described the system at Monmouth, Ill. This was designed by himself, and employs a septic tank, 70 by 105 ft. and 7 ft. deep. The tank cost $7,300. It is operated at a cost of $1 every two weeks.

In the report of the Committee on Water Supply, as read by Mr. C. B. Burdick, some interesting figures were given concerning the water supply of cities in Illinois. Of the population in cities and towns of more than 1,000 people, exclusive of Chicago, 93 per cent. is supplied by public water works. Of these, 69 per cent. use water purified by filtration. The earliest filtration plant installed in Illinois is that of Lake Forest, where a Jewell filtration plant is used.

The report of the Committee on Roads and Pavements, read by Mr. Gearhart, dealt particularly with fillers for brick streets. As a filler, he stated, sand is cheapest, but it is easily washed out, after which the space between the brick is filled with decaying matter. A filler of Portland cement grout has the disadvantage that it is difficult to tear up a pavement so filled. In addition, it causes a rumbling noise when vehicles are driven over it, and about ten days are required to let it set. Coal tar distillate becomes brittle in the winter, and in summer it melts and flows to the gutter. An asphalt filler gave good results. This cost about 14 cents per square yard.

The last session was called at 2 o'clock Friday afternoon. Mr. R. D. Gregg in a paper described at some length the Wabash Avenue concrete steel bridge at Kankakee. This bridge is 593 ft. long by 46 ft. wide. It is the largest highway concrete bridge in the State.

"Reinforced Concrete Structures" was the subject of a paper by Mr. T. L. Condron. With the aid of a lantern several interesting structures of reinforced concrete were described. The results of tests on reinforced concrete beams made at Purdue University, Massachusetts Institute of Technology, Rose Polytechnic Institute, the University of Illinois and the Boston Transit Commission were summarized. These tests, he said, showed that 1¼ per cent. of cross sectional area of steel gave the most economical reinforcement.

In his paper on "Highway Bridges and Culverts," Mr. Frank W. Ives described the several steps by which the old wooden highway bridge has been supplanted by steel structures. He thought that certain specifications should be adopted by all countries for bridges of the same lengths and capacities.

As the time was limited, the paper by F. G. Ewald on "Grade Crossings" was omitted from the programme.

President Alvord, in making his retiring address, thanked the members of the society for their hearty co-operation and interest. He also praised the work of the special committees. He then presented to the members the newly elected president, Mr. D. H. Maury, who spoke of the valuable services of his predecessor and of the record made by the society, and its increased membership.

The convention was then adjourned.

APPARATUS FOR THAWING PIPES.

At this season of the year there is natural and renewed interest in the subject of thawing out by electricity frozen water pipes, in which a large amount of work has been done by central stations, during the past few winters. There is no doubt that in this novel branch of industry an honest penny can be turned by many plants, and a handy, convenient outfit for the work will, therefore, be purchased by them.

The Pittsburg Transformer Co., of Pittsburg, Pa., is now manufacturing a "pipe thawer" outfit. It weighs only 235 lbs. and with its application water will usually begin to flow in 5 or 10 minutes, slowly at first and increasing to normal volume as the ice is melted or washed away in small fragments. The outfit consists of a transformer adapted to operate on any circuit of approximately 1,100 or 2,200 volts and 60 or 133 cycles. The transformer will deliver a current of 300 amp. continuously or currents of about 600 amp. for periods of half an hour. On the back of the transformer are mounted a heat indicator and a choke coil. The heat indicator consists of a section of lead pipe, connected in series with the transformer, and the temperature which this assumes is a guide as to the heating of the pipe under treatment. The choke coil consists of a few turns of heavy copper bar, with a movable laminated iron core. When this plunger is pushed entirely into the coil the transformer secondary may be short-circuited, but no more than normal current will flow. One secondary lead is connected to the pipe inside the house and the other lead inside a neighboring house or to any nearby hydrant.

CALENDARS FOR 1905.

A good example of an effective black-and-white calendar is that issued by the John A. Roebling's Sons Co. of Trenton, N. J., which is decorated with reproductions of many photographs showing the wide range of uses to which wire and rope are now applied. The Pittsburg Meter Co., East Pittsburg, Pa., has issued a perfectly plain wall calendar of large size. The National Electric Co., Milwaukee, issues the most artistic calendar, in some respects, that has been received; it is a color reproduction of a hunting scene by Thomas Blinks. The only embossed calendar that has been received this year has a handsomely executed female bust entitled "Success;" it is published by the Hunkins-Willis Lime & Cement Co. of St. Louis, southwestern distributing agents for Atlas cement. One of the largest wall calendars is that of the Healy Sewer Machine & Construction Co., 10 Tremont St., Boston. The Joliet Bridge & Iron Co., Joliet, Ill., prints a view of a five-span railway bridge on its calendar. The Masurite Explosive Co., New York, prints on its wall calendar directions for using its flameless cartridges. The Nitro Powder Co., Kingston, N. Y., has a well lithographed group of children as the decorative feature of its calendar.

The 15-ft. girders of the Willis Avenue bridge over the New York, New Haven & Hartford R. R. and the Harlem River, New York City, were painted with Dixon's silica-graphite paint four years ago. A folder issued by the Joseph Dixon Crucible Co., Jersey City, N. J., contains a view of one of the girders that has been exposed to the gases, cinders and steam from the stacks of the locomotives on the tracks below during that time.

BUSINESS NOTES.

The Alma Cement Co., Mr. B. B. Lathbury, president, announces the removal of its general sales office on Feb. 1 from the Land Title Bldg., Philadelphia, to Wellston, O., where all communications should be sent hereafter.

The Broderick & Bascom Rope Co., St. Louis, Mo., has received from the Louisiana Purchase Exposition a grand prize for wire ropes in the Mines & Metallurgy Bldg., a grand prize for wire ropes in the Manufactures' Bldg., and a grand prize for underground wire-rope haulage, in addition to other awards.

The Neptune Meter Co. has moved its main offices from Newark, N. J., and Long Island City to 120 Liberty St., New York, where all correspondence should be addressed. All meters for repairs should be shipped direct to the factory at Jackson Ave., Long Island City, N. Y.

The elevator firm of Morse, Williams & Co., Philadelphia, with branch offices in Boston, New York, Baltimore and Atlanta, have added another to the list by opening an office at 1018 Penn Ave., Pittsburg, for the sale and erection of all classes of freight and passenger elevators. It will be in charge of a practical elevator man prepared to submit preliminary plans and specifications desired by architects, builders or owners. This firm has thirty years' experience and a record of 17,000 elevators sold. They also manufacture and install hand elevators and dumb waiters.

On Jan. 19 fifteen men sailed from New York for Mexico, all conduit experts in the employ of G. M. Gest, the subway contractor, of New York and Cincinnati. These men will carry out a contract Mr. Gest has in the city of Mexico for building a subway system through the entire city for the Mexico Light & Power Co. Several complete carloads of tools have been forwarded bv the all-rail route. This is one of the largest contracts Mr. Gest has ever undertaken, and the awarding of such a large contract to him is an indication of the appreciation of his handling of conduit affairs in this country. Mr. Gest expects to send other crews abroad on work, which is now just being put in contract form.

The Chaquette Dredging & Contracting Co., 25 Broad St., New York, has nearly finished its first pneumatic bucket. This is of the clamshell type, with the piston rod and air cylinder hinged to the leaves in such a way that the outward motion of the piston rod closes the leaves.

A high-head centrifugal pump of unusual capacity has recently been built by the Bvron Jackson Co. Machine Works, of San Francisco for the Golden Drift Mining Co., Grants Pass, Ore. It weighs 40 tons and has a capacity of 9,000 gal. per minute against a head of 580 ft. It is direct-connected to four 400-h.p. turbine wheels.

The entire exhibit of the Goldschmidt Thermit Co., at the Louisiana Purchase Exposition, which was awarded a grand prize, has been presented to the National Museum at Washington, at the request of its authorities. The collection gives a complete picture of various applications of alumino-thermics and consists of: (1.) Large and bulky pieces of pure, rare metal, free from carbon, such as chromium, manganese, molybdenum, ferro-vanadium, ferro-titanium and others. (2.) Diagrams and models showing the numerous applications developed by Dr. Hans Goldschmidt, of his process of utilizing the heat of thermit. (3.) Numerous pieces, welded girder rails, in particular, showing the very successful operations performed by this process in joining and fusing iron and steel, and models and specimens of the appliances used. The Goldschmidt Thermit Co. parted from this collection with considerable regret, but the thought that the embodiment of the progress made in a few years in the alumino-thermic science would find a permanent home in the National Museum, caused them to make the sacrifice.

Work on the sub-station that the Spring River Power Co. is building near Joplin, Mo., is complete and arrangements will be made to turn on power early in Feb. This is one of four sub-stations, each of 750 kw. capacity, that are to be supplied from a power plant at Lowell, Kan., where generator capacity of 3,000 kw., direct connected to water turbine, is installed. Power is to be supplied to the zinc mines in this section. The engineering as well as the entire work of construction in connection with this development has been done by the Arnold Electric Power Station Co., of Chicago.

The Northern Engineering Works, Detroit, Mich., crane manufacturers, report among recent shipment and installations of electric and hand power cranes, the following: Union Electric Co., Dubuque, 15-ton; American Production Co., 10-ton electric crane; Detroit Edison Co., Delray, Mich., 30-ton alternating electric traveling crane; Edison Illuminating Co., 7½-ton; Union Brass & Fdy. Co., Lowell; Kenton, O., Marble Co., 8-ton traveling crane. They report an increased demand for their crane and electric hoists, with an excellent outlook. The Thatcher Furnace Co., Newark, N. J., has been adding to its foundry equipment and has installed a 16-ton-per-hour Newton patent cupola, made by the Northern Engineering Works.

F. L. Smidth & Co., of New York, have made one shipment to the Lehigh Portland Cement Co., at West Coplay, Pa., of seven carloads containing three Smidth kominuters and four Davidsen tubemills, to be installed in the revision of the mill "B" plant, and in addition to this have taken the order of the same company for 18 kominuters and tubemills for use in the raw and clinker departments of the new mill "G" to be built in Southern Indiana. They have also contracted with the Lawrence Cement Co., of Penna., to do the engineering work and supply the raw and clinker grinding machinery for the large extension to their plant in Siegfried, Pa. Orders for kominuters and tubemills have also been received from J. B. Speed & Co., of Louisville, Ky., for their new Portland cement plant at Speeds, Ind. The Elk Portland Cement & Lime Co. will reconstruct its mill at Elk Rapids, Mich., using the dry process and Messrs. Smidth & Co. are doing the engineering work as well as supplying some of the grinding machinery.

The Continental Concrete Co., First National Bank Bldg., Pittsburg, has been recently organized to construct reinforced concrete warehouses, factories, residences, floors, culverts and similar work and to manufacture hollow building blocks. The manager of the company is Richard H. Haas.

PERSONAL NOTES.

Mr. E. D. Rich has been reappointed city engineer of Summit, N. J.

Mr. W: B. Howe has been re-elected city engineer of Concord, N. H.

Mr. George W. Snow has resigned as city engineer of Salt Lake City, Utah.

Samuel McLoon, city engineer of Kansas City, Kan., died suddenly on Jan. 15.

Mr. J. W. B. Anderson has resigned as chief engineer of the Canton & Akron, Ohio, Ry. Co.

Henry S. Moulton has been appointed superintendent of the water works of Willimantic, Conn.

Mr. Robert Little has been appointed superintendent of the Niagara Falls, Ont., city waterworks.

Mr. Alfred L. Maggi has been reappointed city engineer and superintendent of streets of Chelsea, Mass.

First Lieut. Paul S. Bond, corps of engineers, U. S. A., has been assigned to duty at Louisa, Ky.

Captain W. F. Van Buskirk, assistant city engineer of Winnipeg, Canada, died recently at Stratford, Ont.

Mr. Chas. Ehlers, superintendent of the bureau of engineering and surveys, Allegheny, Pa., died recently in that city.

Mr. Hamilton Flood has been reappointed city engineer and Mr. Thomas F. Burke commissioner of public works of Quincy, Mass.

Mr. Willam R. King has become associated with Sanderson & Porter, consulting engineers and contractors, 52 William St., New York.

Mr. James Mills has been appointed superintendent for James Stewart & Co., the contractors who are building the docks of the New Orleans Terminus Co., at Chalmette, La.

Mr. W. W. Williams, superintendent of the St. Joseph & Grand Island R. R., and one of the engineers on the construction of the road, died recently at his home in St. Joseph, Mo.

Mr. Wendell P. Brown, engineer for the King Bridge Co., Cleveland, O., has been transferred from the Cleveland office and made eastern representative, in charge of the New York office, 277 Broadway.

Mr. J. B. Cameron, division engineer of the Baltimore & Ohio R. R., at Newcastle, Pa., has resigned to accept a position on the staff of Mr. W. B. Poland, chief engineer of construction of the Alaska Central R. R.

Mr. G. S. McGregory has resigned the management of the Boston office of the Heine Safety Boiler Co., and has been succeeded by Mr. W. E. Muse, formerly connected with the company's general offices at St. Louis.

Mr. Elijah C. Hutchinson has been appointed State Road Commissioner of New Jersey to succeed the late Henry I. Budd. Dr. Frederick C. Jacobson has been appointed a member of the Sewer Commission of the same State.

Mr. C. A. Moreno has resigned as chief engineer of the United Railways Co., of St. Louis, Mo., to take an active part in the management of the Bambrick-Bates Construction Co., of which he has become a large stockholder.

Mr. E. H. Mullin, one of the assistants to President Coffin, of the General Electric Co., died suddenly on Jan. 25. His unique personality and great services to technical journalism are referred to on the editorial page of this issue.

The department of buildings and bridges on the Missouri Pacific-Iron Mountain R. R. has been abolished, and the work of the department will come under the supervision of Mr. M. L. Byers, recently appointed engineer of maintenance of way.

An examination will be held in various cities on Feb. 23 by the U. S. Civil Service Commission, of candidates for a vacancy in the position of civil engineer to act as chief of the division of construction of the office of public road inquiries, Department of Agriculture.

Mr. Chas. R. Pratt has resigned from the firm of Pratt & Van Winkle, 160 Fifth Ave., New York, to devote his time to the Pratt Safety Elevator Co. Mr. Edward Van Winkle will continue the engineering business of the firm and has removed his offices to the Flatiron Bldg.

Captain William W. Maclay, president and general manager of the Glen Falls, N. Y., Portland Cement Co., has sold out his interests in the company. He is a graduate of the U. S. Naval Academy at Annapolis and was in the New York Dock Department for a number of years.

Mr. George E. Gifford, for many years eastern representative of the King Bridge Co., Cleveland, O., has resigned that position to accept the position of contracting engineer in charge of railroad and bridge work for Milliken Bros., with headquarters at their main office, No. 11 Broadway, New York.

Mr. J. C. Jacobson, a well-known mill architect of Grand Rapids, Wis., and Mr. L. A. DeGuere, who has been engaged in the same line of work for several years, at Appleton, Wis., have formed a partnership under the firm name of Jacobson & DeGuere, Grand Rapids, Wis. The firm will devote its attention to mill and power plant engineering and contracting.

The reappointment of Mr. Winslow M. Mead, of Rochester, as deputy superintendent of public works of the State of New York will retain in public service one of the best-posted men in the public works department. He has been connected with the superintendent's office under three administrations, and his reappointment is an indication of the appreciation in which his ability and experience is held at Albany.

Mr. Alfred Craven was recently appointed acting deputy chief engineer of the New York Rapid Transit Railroad Commission. Mr. Craven is a graduate of the U. S. Naval Academy at Annapolis and resigned from the service in 1871. He practiced general civil engineering in Wyoming and Nevada for a few years, after which he was made assistant engineer to the New York Aqueduct Commission. He was at one time in charge of the Jerome Park reservoir, from which work he resigned in 1900 to become division engineer of the New York Rapid Transit Railroad Commission, and the construction of one division of the rapid transit subway on Manhattan Island was practically finished under his supervision.

Mr. Eduardo J. Chibas, of Santiago, Cuba, has been elected vice-president and general manager of the Compania Electrica de Santiago, a corporation operating under a federal concession and municipal charter. It is proposed to supply electric light and power now and construct and operate an electric railway later. Contracts for plant have already been placed with the Babcock & Wilcox Co., Buckeye Engine Co. and General Electric Co. Mr. Chibas is a graduate of the Rensselaer Polytechnic Institute, some of whose work in Central and South America is doubtless known to many readers through interesting papers and discussions contributed by him to the transactions of engineering societies and to the technical press.

Mr. William Whigham, formerly superintendent of the Howard Axle Works, at Homestead, has succeeded Mr. John McLeod as assistant to President A. C. Dinkey, of the Carnegie Steel Co. He will have charge of tests and experimental work. Mr. James H. Grose, formerly superintendent of the beam department of the Homestead mills, will succeed Mr. Whigham. Mr. Louis P. Lincoln has been appointed superintendent of the beam department. Mr. John A. Nichols has been made superintendent of the open-hearth department of the Clairton steel works, and his former position as assistant superintendent of Nos. 1 and 2 open-hearth mills at Homestead has been taken by Mr. William J. Wilkinson. Mr. L. L. Hartzell has been appointed assistant superintendent of the converting mill of the 28-in. and 37-in. mills at Homestead. Mr. Samuel Worton has been made superintendent of the open-hearth department at Donora.

E. Sherman Gould, one of the most widely-known American water-works specialists, died this week at Yonkers. He received his education in this country and in France, and his early engineering work was in connection with anthracite collieries. His reputation as an underground works manager led to his connection with the New Croton Aqueduct for a number of years. After leaving that work he became engineer of the Scranton waterworks, the leading features of which formed the subject of a paper read before the American Society of Civil Engineers about eleven years ago. A little later he designed and built the water-works at Havana, Cuba, which he described in another paper before the same society. He was consulted on a number of important water-works undertakings, and received a decoration from the president of Venezuela for his services as engineering adviser to that republic. Just before his death he reported on a water supply project for the city of Monterey, Mex.

William Sellers, founder of the firm of William Sellers & Co., of Philadelphia, died on Jan. 24. He was born in 1824, on an estate in Pennsylvania that had been in the family since 1682, and was educated at a private school. When 14 years old he was apprenticed to his uncle, who conducted a machine shop, and remained with him until 1845. He then moved to Providence, R. I., to take charge of the shops of Bancroft, Nightingale & Co., manufacturers of steam engines and mill gearing. Two years later he returned to West Philadelphia and began a similar department of manufacturing on his own account. In less than a year he admitted Mr. Bancroft, one of his former employers, to partnership under the name of Bancroft & Sellers. This firm existed until the death of Mr. Bancroft, in 1855. Prior to that time John Sellers, Jr., had been admitted to membership and the firm name became William Sellers & Co. In 1873 Mr. Sellers became president of the Midvale Steel Co., at Nicetown. He subseqeuntly reorganized that company. Five years before his election to the presidency of the Midvale he established the Edge Moor Iron Co., for the manufacture of iron and steel structural material. Mr. Sellers accepted the onerous position of president of the Franklin Institute in 1864, when it was in a critical financial condition. By his energy and wisdom it was reconstructed and placed upon a sound basis. While president of the Institute he proposed the first formula ever offered for a system of screwthreads and nuts, which eventually became the standard for the United States. His firm received commendations and awards for numerous exhibits. At the Paris Exposition of 1889 the highest award, the Grand Prix, was given to William Sellers & Co., together with several medals. At the close of the Exposition Mr. Sellers received an individual diploma, and was also made a Chevalier de la Legion d'Honneur. At Vienna five gold medals and the Grand Diploma of Honor were awarded his firm. The influence and personality of Mr. Sellers were seen in other directions. He was for several years a director of the Reading Ry., and of the Philadelphia, Wilmington & Baltimore R. R. In 1868 he was elected a trustee of the University of Pennsylvania. Fiv years later he was elected a member of the National Academy of Sciences, and in the following year was made corresponding member of the Paris Société d'Encouragement pour l'Industrie Nationale.

CONTRACTING NEWS

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGINEERS AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

******San Diego, Cal.*—Contracts for sewer and water works improvements (bids opened Jan. 19) are stated to have been awarded as follows: C. i. water main extension, Stanley Constr. Co., San Francisco, $48,799; wooden water mains, Stansberry & Powell, Los Angeles, $24,450, and sewer extension to P. H. Howard and John F. Long, Los Angeles, $82,712.

Plant City, Fla.—S. E. Mays, Jr., writes that he proposes constructing water works here, at a cost of $20,000.

Pocatello, Idaho.—Bids will be received by the Pocatello Water Co. on Mar. 31 for a supply of water meters, as advertised in The Engineering Record.

Chariton, Ia.—Bids are wanted Mar. 1 for furnishing material and constructing water works. Jas. Heidricks, City Clk.

Cherokee, Ia.—The Bd. of Control at Des-Moines, writes in regard to improvements contemplated to the water works at the State Hospital at Cherokee, that nothing will be done except lay some water mains.

Waverly, Kan.—See "Power Plants, Gas and Electricity."

**Lakeland, Ky.*—The Supt. Central Asylum for Insane, Lakeland, writes that Lewis & Kitchen, 433 Wabash Ave., Chicago, Ill., have secured the contract for constructing a reservoir at the Asylum (bids opened Jan. 14), for $26,550.

Baton Rouge, La.—Bonds recently sold by City Council are to be used as follows: $60,000 for purchasing old water works or constructing new water works; $25,000 for sewerage work; $25,000 for city's porton of street paving, and $25,000 for new school. R. Swart, City Engr.

Mansfield, La.—The citizens are reported to have recently voted in favor of issuing $20,000 bonds for the construction of water works.

Brockton, Mass.—The Bd. of Aldermen is stated to have passed a resolution providing for the issue of $50,000 bonds for water works construction, and $30,000 for new sewers.

Easthampton, Mass.—Jos. W. Wilson, Town Clk., writes that the citizens voted Jan. 21 to secure a water supply from Sodden and North Brook in Westhampton.

Glenwood, Mich.—The citizens are reported to have voted Jan. 18 in favor of issuing $15,000 bonds for the construction of water works.

**St. Paul, Minn.*—Contracts for furnishing material for the Water Dept. during the year are stated to have been awarded on Jan. 20, as follows: The U. S. Cast Iron Pipe & Fdry. Co., for c. i. pipe, for a total of about $25,000. The Comrs. agreed to purchase not less than 850 tons of pipe at $26.95 per ton. The Comrs. are also allowed to purchase an additional 300 tons if necessary; to the South Park Fdry. & Machine Co., for valves at a total of about $1,200; to the Crane & Ordway Co., for valves and service pipes, for about $3,000.

Trenton, N. J.—Bids will be received Feb. 7 by the Common Council, for furnishing material and lighting, extinguishing and maintaining gas Welsbach and naphtha Welsbach lights on streets and public places of city, for a period of 1, 2 or 3 years. Harry B. Salter, City Clk.

Lumberton, N. J.—G. F. Ried, of the Lumberton Light, Water & Sewage Co. writes that bids will probably be asked for in about 3 months for the construction of water works, to cost $10,000.

Asbury Park, N. J.—Bids will be received by John L. Coffin, Supt. Dept. Water and Sewers, on Feb. 13 for furnishing and erecting a 200-h.-p. internal furnace tubular boiler, as advertised in The Engineering Record.

Glens Falls, N. Y.—The Town Trus. are stated to have decided to install water meters, at a cost of about $15,000.

Albany, N. Y.—A bill has been introduced in the Assembly authorizing the city to expend $400,000 for an additional water supply.

Buffalo, N. Y.—Local press reports state that Francis G. Ward, Comr. of Pub. Wks., has been authorized to prepare plans and specifications for a new fire pumping station bet. Porter Ave. and Jersey St.; a fireproof building to replace old pumping station, and a 30,000,000-gal. steam pump and a 20,000,000-gal. electrical pump.

**Brooklyn, N. Y.*—John J. Cashman, 44 Court St., has secured the contract for furnishing, delivering and laying high-pressure fire-service mains and appurtenances in Brooklyn Boro. (bids opened Jan. 6), for $792,601. For list of detailed bids received for this work, see issue of The Engineering Record of Jan. 14.

Rochester, N. Y.—The Rochester & Lake Ontario Water Co. is reported to have in contemplation the extension of its mains to towns east and west of the city, build two pumping stations, and lay two lines of pipe.

Schoharie, N. Y.—Bids will be received by H. F. Kingsley, Village Clk., Feb. 22 for the construction of water works, as advertised in The Engineering Record.

Elyria, O.—F. R. Faurer, City Aud., writes that the citizens have voted to issue $50,000 bonds for improvements to the water works.

Newark, O.—C. H. Wells, City Engr., writes that no bids were received on Jan. 21 by the Bd. of Pub. Service for the construction of water works, because of injunction proceedings in the Court of Common Pleas. Work will be readvertised later.

Toledo, O.—The Bd. of Pub. Service is stated to have on Jan. 15 approved the general plans for the new water-works filtration plant, and Consulting Engr. Chas. S. Parmelee was instructed to present them to the Ohio State Bd. of Health for approval.

All bids opened on Jan. 19 for $500,000 bonds, to be used for the construction of the new filtration plant, are stated to have been rejected, and new bids will be received.

Norwood, O.—Bids will be received Feb. 18 by the Bd. Pub. Service for furnishing 2 horizontal return tubular boilers, brick work including furnaces, and concrete foundation for setting said boilers, and 1 steel smokestack and breeching therefor.

Ione, Ore.—It is reported that bids will be received Feb. 1 by C. J. Pennington, City Recorder, for constructng water works.

Athena, Ore.—A. G. Chamberlain, City Recorder, writes that the city, through David Taylor, Mayor; C. A. Barrett, Councilman, and others, have negotiated for a spring about 2½ miles from town, and will try to have city charter amended to increase bonded indebtedness to install a gravity water system. As soon as charter is amended, an election will be held to vote on the question.

Lebanon, Pa.—There is reported to be some talk here of securing a new water supply from Swatara Creek. T. R. Crowell, City Engr.

Providence, R. I.—The City Council and Bd. of Aldermen have passed a resolution to improve the water supply, at a cost of $300,000, to include two new filter beds at Pettaconset, and the laying of a leading main 36 or 42-in. diam. from Sockanosset reservoir to city. Walter F. Slade, Comr. Pub. Wks.

Shenandoah, Va.—Chas. H. Dann, Town Clk., writes that D. S. Louderbach is Chmn. of Com. which will have charge of water works; probable cost, $20,000. Engineer, A. C. Walker, of Shenandoah.

Crandon, Wis.—G. A. Lancaster, Deputy City Clk., writes that an election will be held on Feb. 4 to vote on issuing $30,000 bonds for water works. Engineer, Geo. C. Morgan, of Chicago, Ill.

Milwaukee, Wis.—Plans have been prepared for engine foundation and outlet of Kinnickinnic River flushing tunnel, foundation for engine No. 5 at North Point (Milwaukee Water Works) and for new conduit at inlet for Milwaukee River flushing tunnel, and bids will soon be asked.

Plans for buildings of Kinnickinnic River Flushing Tunnel Pumping Works are now being prepared.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

San Diego, Cal.—See "Water."

Santa Rosa, Cal.—City Engr. L. E. Ricksecker has completed and presented to City Council a report for a new sewerage system on the south side and for the extension of the sewerage system on the north side; he estimates the total cost of the work at $38,419.

**Washington, D. C.*—The following are reported to be the bids opened by the District Comrs. Jan. 19 for furnishing and delivery of vitrified sewer invert brick—*a*, 600,000 delivered near Shepherd's branch; *b*, 300,000 delivered at Washington (price given per M); Wm. W. Clark, Baltimore, Md. (awarded contract), *a*, $12.25; *b*, $11.80. Savage Fire Brick Co., Johnstown, Pa., *a*, $16.75; *b*, $16.50. Jas. M. Porter, Pittsburg, Pa., *a* and *b*, $17.50. D. P. Guise, *a* and *b*, $17.65. Clay Product Co., Philadelphia, Pa., *a*, $17.95; *b*, $16.95. Mack Mfg. Co., Philadelphia, Pa., *a*, $18.96; *b*, $17.50.

Atlanta, Ga.—Local press reports state that the apportionment sheet about to be presented to Council will contain an appropriation of $50,000 for beginning work on a septic tank or disposal plant to be located at the mouth of Proctor Creek sewer.

**New Albany, Ind.*—P. J. McNerney & Co., of Brownstown, are stated to have secured the contract for constructing a complete system of sewerage (bids opened Jan. 2), for $207,310.

Logansport, Ind.—W. A. Osmer, City Engr., has been instructed to make surveys and estimates for the extension of the sewerage system to consist of about 6 miles of mains and laterals.

Keokuk, Ia.—J. Ross Robertson, City Engr., is preparing plans for about 2,000 lin. ft. of sanitary sewers, to be constructed in the spring.

Topeka, Kan.—Bids are wanted Feb. 6 for constructing a system of sewers in Dist. No. 26 in 3d and 6th wards; probable cost of work, $85,000. J. H. Squires, City Clk.

Lexington, Ky.—P. P. O'Neill, City Engr., writes that $25,000 will be expended this year in connection with the main trunk sewers. Contracts will probably be let the latter part of March.

Covington, Ky.—W. E. Gunn, City Engr., in his annual report urges the necessity of extending Willow Run sewer to the Ohio River on the north, and the corporation line on the south.

Baton Rouge, La.—See "Water."

Boston, Mass.—The Common Council on Jan. 20 passed a loan order for $800,000 for sewerage construction.

Brockton, Mass.—See "Water."

Quincy, Mass.—The City Council is stated to have passed a resolution authorizing the Mayor to petition Legislature for authority to borrow $200,000 to extend the sewerage system.

Salem, Mass.—The Sewerage Comn. is stated to have decided to call for plans and specifications and ask for an appropriation for completing the construction of the sewerage system.

Menominee, Mich.—The City Council has authorized Albert Hass, City Engr., to prepare plans and specifications for sewers on a number of streets; also for paving 5 streets.

St. Paul, Minn.—Bids will be received Jan. 30 by the Bd. Pub. Wks. for constructing a sewer in a portion of Summit Ave. R. L. Gorman, Clk.

Bids will be received Feb. 2 by the Bd. Pub. Wks., for constructing sewers in portions of Duluth Ave., Yankee and Superior Sts. R. L. Gorman, Clk.

Gulfport, Miss.—The Mayor and Bd. of Aldermen are stated to have passed a resolution providing for the issue of $20,000 bonds for a sewerage system and $20,000 for the erection of a city hall.

North Platte, Neb.—Wm. Yost, City Clk., writes that Andrew Rosewater, of Omaha, is the engineer for the proposed sewerage system; probable cost of work, $30,000.

Bogota, N. J.—Bids will be received Feb. 14 by the Boro. Road Com., Larch Ave., for constructing sewers in portions of several streets, requiring about 6,445 ft. 8 to 24-in. pipe sewer, 23 manholes, together with all appurtenances. Lemuel Lozier, Engr., Bank Bldg., Main and Meier Sts., Hackensack. Peter F. Hopper, Chmn.

New Rochelle, N. Y.—According to reports, bids will be received Feb. 23, instead of Feb. 15, as previously stated by the Bd. Sewer Comrs. (Geo. ,,. Sutton, Chmn.) for constructing approximately 1,875 ft. 30-in. submerged c. i. pipe sewer under the waters of an arm of Echo Bay. The work also includes the construction of a sand catcher, rising well, and other appurtenances. Jas. Knapp Wilkes, Engr.

**Mamaroneck, N. Y.*—Press reports state that Alex. S. Traub, of New York, and Howman Bros., of Reading, Pa., have secured contracts for the construction of sewers here, at a total cost of $25,000.

Brighton, N. Y.—The citizens on Jan. 18 voted not to issue $50,000 bonds for the construction of a sewerage system as proposed. This village will probably be annexed to the city of Rochester within a short time.

Columbus, O.—The Council has passed on second reading additional bond ordinances amounting to $228,500, for the construction of sewers on the west side.

Dayton, O.—The lowest bid opened on Jan. 20 by the Bd. of Pub. Service for constructing sewers in one portion of Dist. No. 4 was submitted by Wm. Rehling, for $2,697. This work consists of 2,880 lin. ft. 8 and 18-in. pipe sewers, 4 manholes and 1 flushtank.

Bids were opened same time and place as follows for constructing sewers in another portion of Dist. No. 4: Wm. Rehling, $8,549; Wm. Hilt, $9,508; Geo. R. Hively, $9,916; W. C. Kershner & Co., $11,152, and David Beard, $14,863. The detail bid of Wm. Rehling, the lowest bidder, is as follows: 6,930 ft. 8-in. pipe, .165 cts. per ft.; 2,360 ft. 10-in, 23 cts.; 9,290 lin. ft. excav., 15 cts. to $1.20 per ft.; 21 manholes, ea. $24; 8 flushtanks, ea. $25, and 10 lampholes, ea. $2.

Ravenna, O.—Sewer bonds amounting to $40,000 are reported sold.

Lorain, O.—The City Council is stated to have authorized the construction of a $45,000 storm sewer bet. Woodland Ave. and Black River.

Toledo, O.—The City Council Com. on Pub. Improv. is stated to have approved the ordinance providing for the construction of a sewer in Summit Ave., Orange, Spielbusch, State, Union, Woodruff, and other streets, at a cost of $75,000.

Providence, R. I.—Bids are wanted Jan. 30 for furnishing about 59 tons special castings and service boxes, including 36 in. castings for force main at Pettaconset, and about 97 tons of castings for sewers required for Water and Sewer Dept. during season of 1905. Walter F. Slade, Comr. Dept. Pub. Wks.

Chattanooga, Tenn.—Mayor Chambliss, in his annual message to Council, recommends an expenditure of $125,000 for improving the sewerage system and the streets, and $100,000 for the erection of a city hall.

**Amarillo, Tex.*—The McQuarters Plumbing & Mchy. Co., of Hillsboro, Tex., is reported to have secured the contract for constructing a system of sewers, bids opened Jan. 16.

Hamilton, Ont.—The Sewer Com. is reported to have authorized the City Engr. to lay out a sewerage system for the annexed district.

BRIDGES.

Notes Arranged Alphabetically by States.

**Trinidad, Colo.*—The contract for constructing a steel trestle bridge 135 ft. in length at Chestnut St., is stated to have been awarded to the Patterson Bridge Co., of Denver, for $9,533.

*The Marsh Bridge Co., of Des Moines, Ia., is stated to have received the contract for constructing a concrete bridge, consisting of 2 spans, each 70 ft. long and 64 ft. wide, at Commercial St., for $28,000.

Bonners Ferry, Idaho.—The construction of a bridge over the Kootenai here at a cost of $30,000, is reported under consideration.

South Bend, Ind.—Reports state that bids will be received Mar. 1, by John W. Harbou, Co. Aud., for $100,000 bridge bonds.

Indianapolis, Ind.—Reports state that bids will be received Feb. 12 by Cyrus J. Clark, Co. Aud., for $170,000 bridge bonds.

Holton, Kan.—Bids will be received Feb. 4, by the Bd. Co. Comrs., for constructing 3 small county bridges. T. C. McConnell, Co. Clk.

Boston, Mass.—See "Paving and Roadmaking."

**Springfield, Mass.*—Robert O. Morris, Clk. Bd. Co. Comrs., writes that the contract for removing and rebuilding portions of piers and abutments of bridge across Connecticut River, between W. Springfield and Chicopee, has been awarded to Rivers & Young, of Holyoke, Mass., for $24,385.

St. Paul, Minn.—See "Paving and Roadmaking."

Minneapolis, Minn.—Bids will be received Feb. 6, by the Bd. Co. Comrs., for rip rapping bridge No. 1, over Mississippi River, in Town of Champlin. Hugh R. Scott, Co. Aud.

**Billings, Mont.*—The County Comrs. are stated to have awarded the contract for constructing a 2-span steel bridge, 620 ft. long here, to the W. S. Hewitt Bridge Co., of Minneapolis, Minn., for $34,700.

York, Neb.—Bids will be received Feb. 20, by the Bd. Co. Comrs., for constructing county bridges for year 1905. C. C. Boislaw, Co. Clk.

North Platte, Neb.—Bids will be received Feb. 6, by the Bd. Co. Comrs., for constructing a single track wagon bridge 3,200 ft. long, 10 ft. wide, with 2 turnouts not less than 16 ft. wide and 72 ft. long, over North Platte River. Fred R. Ginn, Co. Clk.

Patchogue, L. I., N. Y.—At a meeting of the Town Board, of Brookhaven, held at Patchogue, Jan. 21, it was decided to build 2 bridges, one over Patchogue River on Division St., Patchogue, and one at Centre Moriches. The bridges are to be of steel, with concrete foundations and flooring, and bids for their construction, it is reported, will be received Feb. 8. The cost of the Patchogue bridge is to be divided between Patchogue and Brookhaven.

**New York, N. Y.*—Contracts for constructing the anchorages of Manhattan Bridge No. 3, over East River, bids opened on Dec. 22, by the Dept. of Bridges, have been awarded as follows: Manhattan anchorage to the Williams Eng. & Contr. Co., 1 3Park Row, for $1,197,000, and the Brooklyn anchorage to the Kosmos Eng. Co., of Brooklyn, for $1,212,554. For detailed list of bids received for this work, see issue of The Engineering Record of Jan. 21.

Bids will be received Feb. 9 by Geo. E. Best, Comr. of Bridges, for constructing lattice railing on the footwalks of Williamsburg bridge bet. Boro. Manhattan and Brooklyn.

Cincinnati, O.—Bids will be received Feb. 18 by the Bd. Co. Comrs., for constructing culvert and approaches on Bridgetown Road in Green Township. Eugene L. Lewis, Co. Aud.

**Niles, O.*—The Pennsylvania R. R. Co. is stated to have awarded to Chas. Finns & Co., of Pittsburg, Pa., the contract for constructing the double track bridge over the Mahoning River near here, for about $25,000.

Johnstown, Pa.—Mayor Pendry is stated to have approved the ordinance authorizing a $30,000 bond issue to provide funds for the erection of the overhead bridge crossing the P. R. R. tracks in the 12th Ward.

**Harrisburg, Pa.*—The contract for rebuilding substructure and superstructure of a bridge across Penns Creek, in Hartley Township, is stated to have been awarded to the Nelson-Buchanan Bridge Co., of Chambersburg, for $12,900 (bids opened Jan. 10).

Culpeper, Va.—Bids will be received by the joint Comrs. of Culpeper and Spottsylvania Counties, at the County Clerk's office, Culpeper, on Feb. 20, for constructing a steel bridge 224 ft. in length across Rapidan River, as advertised in The Engineering Record.

Pasco, Wash.—It is stated that the Northern Pacific R. R. (E. J. Pearson, Ch. Engr., St. Paul, Minn.) will construct a steel bridge over the Columbia River here, at a cost of $300,000.

Aberdeen, Wash.—The construction of a bridge over Chehalis River here is reported under consideration; probable cost, $40,000.

Oshkosh, Wis.—The following are the bids opened on Jan. 14 by the Bd. of Pub. Wks. (M. Coffey, Chmn.) for constructing superstructure of a bridge across Fox River, between Main and S. Main Sts.; (*a*) Modern Steel Structural Co., Waukesha; (*b*) Worden, Allen & Co., Milwaukee; (*c*) Milwaukee Bridge Co., Milwaukee; (*d*) Jackson & Corbett, Chicago, Ill.; (*e*) Wisconsin Bridge & Iron Co., Milwaukee; (*f*) Russell Wheel & Fdry Co., Chicago; (*g*) C. L. Strobel, Chicago; (*h*) Standard Constr. Co., Chicago; (*i*) Morava Constr. Co., Chicago, Ill.; (*j*) Fridstein & Fridstein, Chicago, Ill.; (*k*) Penn Bridge Co., Beaver Falls, Pa.; (*l*) Newcastle Bridge Co.,

Items marked thus give the names of parties awarded contracts.

Indianapolis, Ind.; (*m*) King Bridge Co., Cleveland, O.

	Totals.	Railing.	Extras, per lb.: Medium or soft steel.	Iron castings.	Steel castings.	Phosphor bronze.
a.	$58,673	$1,475	$0.033	$0.07	$0.08	$0.30
b.	58,700	1,740	.044	.045	.07	.40
c.	58,800	2,000	.035	.035	.08	.45
d.	59,590	2,856	.065	.06	.15	.60
e.	59,982	3,200	.0374	.04	.05	.35
f.	59,861	4,000	.04	.04	.07	1.00
g.	60,900	2,060	.045	.045	.075	.50
h.	63,960	2,000	.06	.06	.12	.50
i.	64,440	3,000	.08	.06	.10	.40
j.	65,400	3,800	.06	.06	.10	.40
k.	67,200	2,200	.0425	.054	.088	.50
l.	70,800	3,400	.0475	.08	.11	.55
m.	71,600	2,600	.047	.075	.085	.40

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

Grass Valley, Cal.—It is stated that bids will be received Mar. 1 by the Bd. Supervs. for constructing a road. F. L. Arbogast, Clk.

Cornwall, Conn.—Bids will be received Feb. 15, by the Town Bd. Selectmen for grading 4 sections of road in said town. John E. Calhoun, Chmn.

Jacksonville, Fla.—Bids will be received Feb. 13, by the Bd. Pub. Wks., for grading about 37,800 sq. yds., for furnishing and laying about 37,800 sq. yds. vitrified paving bricks or blocks, and 21,100 lin. ft. stone curbing on portions of several streets. Philip Prioleau, City Engr.

Indianapolis, Ind.—Bids will be received Feb. 10 by the Bd. Park Comrs. for furnishing material and constructing a boulevard from Capitol to Central Ave.; estimated cost, $72,000. Hiram Brown, Chmn.

Bedford, Ind.—Reports state that bids will be received Feb. 6 by Walter G. Owens, Co. Aud., for $44,680 gravel road bonds.

Davenport, Ia.—Thos. Murray, City Engr., estimates the cost of paving four streets including 4th and Pine Sts. and Western Ave. with asphalt at $77,000. Edw. Collins, City Clk.

Leesville, La.—It is reported that bids will be received Feb. 15, by J. J. Cryer, Pres. Police Jury, Vernan Parish, for grading 30 miles of public road. C. H. Oak, Clk.

Baton Rouge, La.—See "Water."

Worcester, Mass.—Separate bids are wanted Feb. 6 for furnishing approximately 35,000 lin. ft. curbstone, 2,000 lin. ft. circular curbstone, 12,000 sq. yds. paving blocks, etc. Walter E. Hassam, Street Comr.

Boston, Mass.—The Cambridge Bridge Comn. on Jan. 24 opened bids for furnishing cut granite curb, and about 325,000 granite paving blocks for the new Cambridge Bridge. For the curb there were 9 bids, the lowest being by John Harrington, of Boston, for $20,312. For the paving blocks there were 5 bids, the lowest being the Pigeon Hill Granite Co., at $51 per M.

Menominee, Mich.—See "Sewerage and Sewage Disposal."

Grand Rapids, Mich.—It is stated that the City Engr. has reported his estimate for the cutting down of W. Bridge St. hill from Lincoln St. to the city limits. The expense is placed at $66,210. In this is included $19,000 for concrete retaining walls. He also estimates the cost of paving with brick W. Bridge St. from Stocking to Lincoln St., at $38,100.

Calumet, Mich.—It is stated that about $100,000 will be expended for improving with brick and asphalt, the principal streets in this city.

Flint, Mich.—The Common Council has voted to purchase a 10-ton steam road roller. A. W. Hall, City Engr.

**St. Paul, Minn.*—L. G. Washington is stated to have received the contract for laying about 400,000 sq. ft. of cement sidewalks during 1905, for $40,821.

*The contract for constructing wooden sidewalks during 1905 is stated to have been awarded to P. J. Ryan, for $14,870.

Bids will be received Feb. 2 by the Common Council for repairing paved streets; also for repairing asphalt pavements. L. W. Rundlett Comr. Pub. Wks.

St. Paul, Minn.—Bids will be received Feb. 2, by the Common Council for reflooring and paving 3d St. bridge. Geo. T. Redington, City Clk.

Meridian, Miss.—Street Improvement Bonds amounting to $160,000 are reported sold.

Omaha, Neb.—The following bids are stated to have been received Jan. 13, by the Bd. Pub. Wks., for constructing an asphalt repair plant: The Toledo Constr. & Supply Co., $8,750 and $8,520 for a portable plant; The Iroquois Iron Works, of Buffalo, N. Y., $14,635; F. D. Cummer & Son, of Cleveland, O., $9,850; Geo. Adgate, of Omaha, $10,000, and the Star Machine Works, of Indianapolis, $7,500.

Nashua, N. H.—The Bd. of Pub. Wks. will ask City Council for an extra appropriation of $15,000 to pave Main St. from Nashua River Bridge to Pearl St., with bitulithic macadam. E. J. Johnson, City Engr.

Jersey City, N. J.—Bids will be received Jan. 30 by the Bd. Street and Water Comrs., for improving a portion of Logan Ave.; estimate of quantities, 1,230 cu. yds. earth excav., 2,425 sq. yds. Belgian paving, 1,485 lin. ft. stone curb set in concrete, 5,900 sq. ft. flagging, etc. Geo. T. Bouton, Clk.

Atlantic City, N. J.—Press reports state that the City Council on Jan. 23 killed the order providing for the paving of Atlantic Ave. with asphalt.

Wildwood, N. J.—It is stated that the Borough Council will soon ask for bids for constructing 125,000 sq. ft. cement sidewalks and 25,000 lin. ft. cement curbing.

North Hempstead, L. I., N. Y.—Paving bonds amounting to $20,000 are reported sold for improving Middle Neck Road in Great Neck.

Dunkirk, N. Y.—Bonds amounting to $233,330 are reported sold for improving Elk St.

Albany, N. Y.—Bids will be received Feb. 6 by the Bd. Contract and Supply for furnishing material, grading, curbing, paving carriageway with asphalt blocks, repairing sidewalks and constructing receiving basins on a portion of S. Pearl St. Isidore Wachsman, Clk.

**New York, N. Y.*—The following are the bids opened on Jan. 17 by the Dept. of Docks & Ferries, for preparing for and paving with asphalt, the decks of three piers, (*a*) Pier 60, 10,600 sq. yd.; (*b*) Pier 61, 10,600 sq. yd.; (*c*) Bloomfield St. pier, 3,100 sq. yd.; (*d*) total: Sicilian Asphalt Paving Co., Times Building; *a*, *b*, and *c*, $1; *d*, $24,300 (awarded contract; Uvalde Asphalt Paving Co., 1 Broadway, *a*, 98 cts.; *b*, $1; *c*, $1.08; *d*, $24,336; N. Y. & Bermudez Co., 114 Liberty St., *a* and *b*, $1.11; *c*, $1.06½; *d*, $28,833; Warner-Quinlan Asphalt Co., 32 Broadway, *a*, *b*, and *c*, $1.60; *d*, $38,880.

Bids will be received Feb. 7 by Maurice Featherson, Comr. of Docks, for furnishing material and repairing asphalt pavement along North and East Rivers together with all work incidental thereto.

Canajoharie, N. Y.—Bonds amounting to $20,000 are reported sold for improving roads in Montgomery County.

Cincinnati, O.—The following are the bids opened on Jan. 18 by the Bd. of Pub. Service, for the improvement of Court St., (*a*) F. H. Kirchner, (*b*) Warren Bros. Co., (*c*) Henkel & Sullivan:

		a.	*b*.	*c*.
9,650 cu. yd.	concrete in drainage and retaining walls	$6.00	$6.20	$6.00
2,260 lin. ft.	granite curbs	1.30	1.28	1.15
250 "	circular curb	2.00	1.98	2.00
36,500 cu. yd.	excavation	.53	.55	.55
5,640 sq. yd.	grading and rolling	.10	.09	.10
100 cu. yd.	extra stones for fill	2.00	2.00	2.00
940 "	crushed stone foundation	2.25	2.21	2.25
100 "	Portland cement concrete	6.00	6.00	6.00
5,640 sq. yd.	bitumen on foundation	.25	.23	.25
5,640 "	wearing surface and binder	1.60	1.58	1.75
5,640 "	bituminous flush coat	.15	.14	.15
5,640 "	stone chips finished surface	.10	.10	.20
5,640 "	pat. rights and service granted 25c. a yd.	.25	.25	.25
16,200 lbs.	castings	.04	.03¾	.04
2,500 lin. ft.	3-in. drain pipe	.15	.15	.10
900 "	12-in. " "	1.00	.96	1.00
550 "	15-in. " "	1.25	1.23	1.25
596 "	18-in. " "	1.50	1.44	1.50
1,850 "	wall railing	1.50	1.47	1.50
150 "	crossings redressed and reset	.25	.25	.10
28 pieces	railing posts	5.00	4.75	7.00
28 pieces	Palmer traps	7.00	6.90	5.00
150 sq. yd.	granite repaving	1.00	1.00	1.00
	Total	$104,219	$106,264	$105,872

Mt. Gilead, O.—Bids are wanted Feb. 8, for grading and paving with brick or block a portion of High St. Wm. F. Wieland, Clk. Bd. Pub. Service.

Cleveland, O.—Bids will be received Feb. 8 by the Bd. Pub. Wks., for grading, draining, curbing and paving with brick, portions of numerous streets. A. R. Callow, Secy.

**Cincinnati, O.*—The contract for paving with bitulithic on a portion of E. Court St. is stated to have been awarded to F. H. Kirchner, for $104,219.

**Oklahoma City, Okla. Ter.*—Paving contracts amounting to about $125,000 are reported to have been awarded as follows: 3d St. with asphalt, to the Cleveland Trinidad Asphalt Paving Co., Cleveland, O.; Reno Ave. with brick to Fuller & Hipple, and E. Main St. and E. Grand and Oklahoma Aves. to Southern Improvement Co.

Philadelphia, Pa.—City Council passed an ordinance on Jan. 20, providing for an appropriation of $2,000,000 to begin work on the Parkway between Logan Sq. and 25th St.

Harrisburg, Pa.—Mayor McCormick in his annual message recommends an appropriation for grading and macadamizing Derry St.

Meadville, Pa.—Plans have been submitted to Council for the paving of Park St., from Chestnut to Linden St., with brick or asphalt block; estimated cost, including storm sewers, $27,000. W. A. Doane, City Engr.

Tacoma, Wash.—It is proposed to pave with asphalt S. 17th St. and Jefferson Ave., at a cost of $15,000. Frank L. Davis, City Engr.

Bids will be called for about the latter part of March for about 8 miles of asphalt paving.

La Crosse, Wis.—City Engr. Powell is stated to have estimated the cost of paving a portion of Jackson St., at $14,483.

POWER PLANTS, GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

**Little Rock, Ark.*—F. M. Oliver, City Clk., writes that the contract for furnishing and installing a 350-h.-p. boiler and equipment at electric-light plant (bids opened Jan. 18) has been awarded to E. H. Abadir & Co., of St. Louis, Mo., for $7,480.

Colton, Cal.—N. Davenport, City Clk., writes in regard to establishing a municipal electric light and power plant, that no action has yet been taken in the matter.

Fullerton, Cal.—G. A. Ruddock, City Clk., writes that F. W. Butler, of Orange, has secured the franchise for a gas plant (bids opened Jan. 16).

Marysville, Cal.—Jas. O'Brien, L. H. Mitchell and John E. Ebert, of Marysville, are reported to have filed in the office of County Recorder a notice of a location claim to 100,000 inches of water of Yuba River, to be diverted at the narrows by means of a dam and conveyed by ditches to the Sicard flat crossing, where water will be used for generating electric power, and to Honcut Creek for irrigation purposes. All surplus water will be returned to the Yuba River through Dry Creek. The purposes for which the water is to be appropriated are mining, milling, irrigation and generation of electric power, to be used in Yuba, Butte, Nevada, Placer, Sacramento, Contra Costa, Solano, Marin, Santa Clara, San Mateo, Yolo and Alameda Counties.

Eureka, Cal.—The North Mountain Power Co. has applied for a franchise to construct, maintain and operate, over certain public roads and highways in Humboldt Co., poles, masts and other superstructures upon which to suspend wires and other appliances for transmitting electric power, and bids for said franchise will be received Feb. 14 by W. H. Haw, Clk. Bd. Supervs.

Washington, D. C.—The following are reported to be the bids opened by the Bureau of Yards and Docks, Navy Dept., Washington, on Jan. 23 for supplying a 29-panel switchboard for the navy yard in this city: The National Electric Supply Co., Washington, $17,900; Arthur Tratzen Co., Chicago, Ill., $14,539; H. O. S. Eng. Co., Newark, N. J., $14,895; Welker Electric Co., of Philadelphia, Pa., $14,370; Weston Electric Co., of New York, N. Y., $13,000; General Electric Co., of Schenectady, N. Y., $11,979; Southern Electric Co., of Baltimore, Md., $14,519; Albert & J. M. Anderson, of Boston, Mass., $13,530, and Cutler Electric Co., Philadelphia, Pa., $14,975.

**Post Falls, Idaho.*—Nelson Bennett, of Tacoma, Wash., is reported to have secured the contract for building the power plant at Post Falls for the Washington Water Power Co., of Spokane (D. L. Huntington, of Spokane, Vice-Pres. and Gen. Mgr.). Contract price reported to be about $130,000.

Chicago, Ill.—The following are the bids opened on Jan. 17 by the Superv. Archt., Treas. Dept., Washington, D. C., for electric-light fixtures, for the Court House and Post Office: Horne-Brannan Co., New York,* N. Y. (2 bids), $21,053 and $21,393; Mitchell, Vance & Co., Philadelphia, Pa. (3 bids), $27,600, $19,917 and $16,880; The T. Wilmarth Co., Chicago (3 bids), $16,880, $20,860, and $27,297. The Enos Co., New York, N. Y. (3 bids), $29,327, $19,930, and $27,478. Cassidy & Son Mfg. Co., New York, N. Y. (3 bids), $19,065, $21,194 and $27,377.

Lafayette, Ind.—Business men of Lafayette are reported to have asked Isham Randolph, Engr. Sanitary Dist. of Chicago, Ill., to make examination of Wabash River at Lafayette, with a view to determining the possibility of developing electric power for the construction of a dam. According to press reports, the cost of the work proposed would be about $5,000,000. Henry A. Taylor, of Lafayette, Pres. American National Bank, is reported to have been asked to finance the deal.

Muncie, Ind.—The stockholders of the Muncie Light & Fuel Co. are stated to have decided to construct an artificial gas plant in Muncie this year. Chas. A. Meeker, Pres., Lafayette.

Muskogee, Ind. Ter.—Three franchises to pipe natural gas into Muskogee are stated to have been granted on Jan. 18 by City Council, to the Success Oil & Gas Co., the Great Chief Oil & Gas Co., and Ira L. Reeves. It is proposed to pipe gas into the city from Tulsa, and possibly from Oklahoma, and each company is given the use of the streets for such purposes.

Ft. Des Moines, Ia.—Bids are wanted Feb. 7 for installing service wiring, transformer and electric light fixtures in gymnasium and post exchange building at this post. Address L. Hardeman, Q. M.

Waverly, Kan.—W. H. Williams, City Clk., writes that Burns & McDonnell, of Kansas City, Mo., are the engineers for the construction of water works and an electric light plant; probable cost of work, $15,000. The question will be voted on Feb. 14.

Ft. Leavenworth, Kan.—Bids are wanted Feb. 10 for furnishing and installing electric fixtures and wattmeters and wiring certain buildings at this post. Maj. D. E. McCarthy, Q. M.

Vidalia, La.—J. W. Wiggins, Mgr., Vidalia Light & Water Co., writes that he will start work about Feb. 1 on the construction of water works, electric light and ice plant combined; probable cost of work, $40,000. He further states that he will do construction work himself as far as practical.

Chestertown, Md.—D. S. Pindell, of Sault Ste. Marie, Mich., is stated to have secured a franchise from the Bd. of Town Comrs. for the erection of pole, wires, etc., for the installation of an electric light plant. The franchise covers a period of 40 yrs. Work on the plant will commence at once.

Cadillac, Mich.—Claude Hamilton, Henry Idema, E. A. Stowe, and others, of Grand Rapids, are stated to have purchased the gas plant at Cadillac. The old company will be reorganized and the new company will be known as the Cadillac Gas Light Co. It is proposed to extend the mains and make other improvements.

Battle Creek, Mich.—This city is reported to have given the Kalamazoo Valley Electric Co. (W. P. Stephens, Supt., Kalamazoo) a franchise for lighting and heating the city. It is reported to be the intention of the Kalamazoo Co. to absorb the Battle Creek Electric Light Co. and secure its water power.

Jackson, Mich.—Press reports state that there is talk of merging the electric companies of southern Michigan into the Commonwealth Co. The present water power will be doubled, and an electric power plant, to cost about $100,000, would be constructed in Jackson. W. A. Foote, of Jackson, Pres. Jackson Light & Power Co., is reported interested.

Grand Rapids, Mich.—A company is reported formed by M. B. Wheeler, R. H. Updyke and Wesley W. Hyde, of Grand Rapids, with a capital of $1,500,000, to manufacture electricity for light and power, and transmitting the current to Whitehall, Montague, Fremont and Muskegon. The company is stated to have petitioned for a franchise in Muskegon.

Laurel, Miss.—The electric light and power plant of the Laurel Improv. Co. is stated to have been destroyed by fire on Jan. 17. Benj. Lee, Ch. Engr., Laurel.

Laconia, N. H.—The City Council of Laconia, is desirous of letting a contract for furnishing arc and incandescent street lighting for a term of 10 years, at a yearly expense of about $7,000. The successful bidder to bring into city from outside sources electric power of at least 500 h.p. For further information address J. G. Quimby, M.D., Chmn. on Lighting Streets, Lakeport, N. H. Advertised in The Engineering Record.

Metuchen, N. J.—The Metuchen Gas & Electric Light Co. is reported organized, with a capital of $50,000. The company will begin at once laying gas mains through Raritan Township and construct a plant at Metuchen. John W. Whelan, of Elizabeth, is Treas.

West Point, N. Y.—Bids will be received by the Quartermaster, U. S. M. A., West Point, on Feb. 15 for the construction and installation of Corliss engines for electric lighting, as advertised in The Engineering Record.

Plattsburg Barracks, N. Y.—Bids are wanted Jan. 31 for furnishing and installing electric light fixtures in 2 double sets officers' quarters and store-house here. Capt. T. B. Lamoreux, Q. M., Burlington, Vt.

New York, N. Y.—The following are the bids opened on Jan. 16 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for electric equipment in (*a*) School No. 63, (*b*) School No. 104, Manhattan Boro.: Reis & O'Donovan, *a*, $13,870; *b*, $7,220. O. K. Electrical Constr. Co., 725 Bway., *a*, $12,140 (awarded contract); *b*, $7,540. Peet, McAnerney & Powers, *a*, $14,139. Fred. Pearce, *a*, $13,836. W. M. Sheehan & Co., 136 Liberty St., *a*, $14,333; *b*, $6,939 (awarded contract). Commercial Constr. Co., *b*, $7,330.

**New Brighton, S. I., N. Y.*—The Plymouth Electric Co. has secured the contract for the electric equipment for School No. 12, Richmond Boro. (bids opened Jan. 16), for $2,165.

Governor's Island, N. Y.—Bids are wanted Feb. 15 for installing electric fixtures in 4 sets officers' quarters here. Traber Norman, Q. M.

Rochester, N. Y.—Bids will be received Jan. 30 by the Bd. Educ., for a system of electric light wires, etc.; also a system of telephones in West High School. J. Foster Warner, Archt., 1036 Granite Bldg., J. S. Mullan, Secy.

Springfield, O.—The People's Heat, Light & Power Co. is reported organized, with a capital of $1,500,000, by John L. Zimmerman, Frank Torrence, Judge F. M. Hagan and others, and will construct a plant here and lay conduits through the city.

Barberton, O.—The Mohican Gas & Oil Co. is stated to have decided to petition Council for a franchise to furnish the village with gas.

Hamilton, O.—The Hamilton, O., Gas, Light & Coke Co. is stated to have changed its name to the Hamilton Gas & Electric Co., and increased its capital to $1,000,000. The company will at once spend about $250,000 in improvements and extensions. A new electric plant is also to be installed.

Bowling Green, O.—The Co. Comrs. are reported to have under consideration the construction of a lighting and heating plant.

****Items marked thus give the names of parties awarded contracts.***

Mt. Union, Pa.—Bids will be received Jan. 31 by the Boro. Council, for a franchise to put in an electric light plant, to furnish city and private concerns with light. Geo. W. Lukens, Secy.

York, Pa.—Local press reports state that plans are now being considered by the York Haven Water & Power Co. for the construction of cable lines to Harrisburg, Steelton and Middletown, for the transmission of electric power. W. F. Bay Stewart, Vice-Pres., York, Pa.

Howard, Pa.—Bids are wanted Feb. 6 for constructing a municipal electric light plant. W. E. Confer, Boro. Secy.

Jefferson City, Tenn.—The plant of the Jefferson City Electric Light & Power Co. is reported to have been destroyed by fire. T. H. Bales, Pres. and Mgr., Jefferson City.

San Antonio, Tex.—C. A. Zilker, Vice-Pres. Southern Ice & Cold Storage Co., is reported interested in the construction of an electric light plant here, to cost about $100,000.

Royse City, Tex.—The Royse City Milling & Light Co. is reported incorporated, with a capital of $20,000, for the purpose of operating a flouring mill and electric light plant. J. N. Miller is one of the incorporators.

Huntsville, Utah.—The citizens are reported to be considering the question of issuing bonds for the construction of a municipal electric light plant.

Manassas, Va.—W. E. Crosen & Co., of Leesburg, are stated to have petitioned the City Council at Manassas for a franchise for the erection and maintenance of a system of electric lights during a period of 15 years. The proposed plant will have a capacity of 750 standard, 16-c.-p. lamps.

Hoquiam, Wash.—The City Council is stated to have granted C. A. Burrows, of Walla Walla, a 25-yr. franchise to furnish gas for lighting and heating purposes. He is also reported to have secured a franchise in Aberdeen.

Benwood, W. Va.—The Ohio Valley Electric Light Co. of Benwood, is reported organized, with Thos. P. Deegen, Pres. and Wm. Leach, Jr., Secy. It is reported to be the intention of the company to increase the old plant by the installation of new and modern machinery and remove the remainder of the McMechen plant to Benwood.

Milwaukee, Wis.—Articles of incorporation have been filed at Madison by the Wisconsin Gaslight Co., of Milwaukee, with a capital of $50,000, by Otto R. Hansen, Geo. A. Rockwell and Carl E. Hansen.

Onalaska, Wis.—D. L. Aiken, and others, are stated to have petitioned for a franchise for an electric light plant.

Manitowoc, Wis.—The City Council is reported to have directed the City Engr. to prepare estimates on the cost of an electric light plant.

**Ft. D. A. Russell, Wyo.*—Capt. W. S. Scott, Q. M., U. S. A., Cheyenne, writes that the Berggren Electrical Co., of St. Paul, Minn., on Jan. 17 secured the contract for installing electric fixtures in certain buildings, at Ft. D. A. Russell, for $2,950.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

Stockton, Cal.—The Stockton Electric Ry. Co. has applied for a franchise to construct, maintain and operate an electric road along certain streets in said city; and bids for said franchise will be received Feb. 27 by Geo. S. Wheatley, Clk. of Council.

**San Francisco, Cal.*—The Warren Improvement Co., of San Francisco, is stated to have secured the contract from the Santa Clara Interurban St. Ry. Co. for the entire construction of the roadbed, including ditching, track laying, etc., from Palo Alto to Mayfield, Cal., a distance of 1¼ miles. This is the preliminary contract on the future electric line to be built from San Mateo to San Jose.

The Bd. of Works has granted a permit to the United Railroads, of San Francisco, to change the present steam railroad from California St. and Central Ave. to the Cliff House into an overhead electric system over the same route. The Supervisors' Street Com. has recommended a resolution granting the United Railroads permission to use electricity on that portion of the road on California St. bet. Parker and 1st Aves.

Danbury, Conn.—The Consolidated R. R. Co. (C. S. Mellen, Pres., New Haven) is reported to have authorized the construction of a new double track from Towners to Danbury, a distance of 18 miles; probable cost of work, $750,000.

Pensacola, Fla.—W. H. Murphy and Warren E. Anderson have petitioned Council for a street railway franchise.

Watseka, Ill.—The Watseka & Kankakee Traction Ry. Co. has been incorporated, with a capital of $25,000, to construct an electric railway from Watseka to Kankakee. Incorporators: David Magill, Geo. W. Hoyt, Walter H. Hogan and others, of Watseka, Ill.

Rock Island, Ill.—The Rock Island, Moline & Davenport Suburban Ry. Co. has been organized to operate a railway between Rock Island and Moline. Directors: John W. Green, Stewart Spaulding and Wm. A. Rawson, of Chicago, and others.

Sweetwater, Ill.—The Springfield, Sweetwater & Peoria Electric Ry. Co. has been incorporated to construct an electric railway from Springfield to Peoria. Incorporators: Geo. W. Hatch, Geenview, Ill.; Thos. H. Alkire, and Augustus K. Jones, of Sweetwater, Ill., and others.

Springfield, Ill.—The Springfield & Western Ry. Co. has been incorporated, with a capital of $100,000, to construct an electric railway from Springfield through the counties of Sangamon, Schuyler, Morgan, Cass, Pike, Brown and Adams to Quincy, Ill. Incorporators: F. M. Mills, D. A. Watson, Geo. A. Wood, of Springfield, and others.

Peru, Ind.—The Central Indiana Traction Co., which is composed of Peru men entirely, proposes to build an interurban line from here to South Bend, paralleling the Lake Erie & Western R. R., from Peru to Plymouth. James O. Cole, Pres.; Jerome Herff, Secy. Capital, $25,000.

Marion, Ind.—The City Council is stated to have granted a franchise to the Kokomo, Marion & Western Traction Co. to enter the city over 5th St.

Wabash, Ind.—A subsidy of $17,000 is asked by the Huntington & Columbus City Traction Co. in aid of its extension through Turkey Creek and Syracuse Townships, in Kosciusko County.

Ft. Dodge, Ia.—The Westinghouse Electric & Mfg. Co. of New York, is reported to be preparing plans, specifications and estimates for the complete electrical equipment of the proposed electric interurban railway between Ft. Dodge, Webster City and Iowa Falls, Ia.

Marshalltown, Ia.—The stockholders of the Marshalltown Electric St. & Interurban Ry. Co. are reported to have announced that funds have been secured from Eastern capitalists to finance the road; the road will be built during the present year, from Marshalltown to Grundy Center, Ia. Directors: A. G. Glick, L. C. Norris, J. M. Parker, C. R. Speers, and others, all of Marshalltown.

Versailles, Ky.—The Woodford County Fiscal Court has granted to Clifford D. Bebee, of Syracuse, N. Y., a franchise and right of way for an electric railway through this county from Lexington via Versailles to Frankfort.

Monroe, La.—A. J. Renand, City Secy., writes that this city is to construct an electric railway.

Milford, Mass.—The Milford & Uxbridge St. Ry. Co. will, as soon as the weather permits, reconstruct a 6-mile section of its line between Milford and Holliston. Eventually it is intended to put in new rails as far as South Framingham, a distance of 12 miles.

Manchester, N. H.—The Derry & Manchester Ry. Co. has been organized by Geo. H. Chandler, Manchester; David F. Perkins, of Londonderry; Edwin N. Whitney, of Derry, and others, to build a road from a point on B'way, W. Derry, to some point in Goff's Falls, Manchester.

Orange, N. J.—A franchise has been passed granting the Morris County Traction Co. the right to build a line in Millburn.

Canajoharie, N. Y.—New York parties are reported to have made propositions to the Bd. of Trade to build and operate an electric railway between this place and Milford.

Cortland, N. Y.—The Cortland County Traction Co. is making preparations for the extension of its line to Little York.

**Ithaca, N. Y.*—The contract for the construction of the Cayuga Heights extension of the Ithaca St. Ry. has been let to the Syracuse Contr. Co.

Greensboro, N. C.—J. W. Menafee, P. O. Box 426, is reported interested in the Alamance St. Ry Co., chartered last fall to succeed the Graham, Burlington & River Falls St. Ry. Co. The company has not yet organized for construction work.

Woodsfield, O.—J. W. Alverton and Dr. A. Norris, it is stated, are promoting the project to construct an electric railway from Woodsfield to Barnesville.

Youngstown, O.—The Youngstown & Southern Ry. Co. is reported to be preparing to place contracts for the extension of the road to Lisbon and East Liverpool, and it is probable that this will be done the coming summer.

Ellsworth, O.—Surveys are being made for a line from this place to Salem to connect the Stark Electric Ry. with the new Canton & Youngstown Ry.

Bucyrus, O.—The Bucyrus, Sulphur Springs & New Washington Traction Co. has been incorporated, with a capital of $10,000, by Ellis Bartholomew, W. E. Mosler, and others, to build a line from Bucyrus to Sulphur Springs, New Washington and Plymouth, where connection will be made with the Sandusky, Norwalk & Mansfield Ry.

Springfield, O.—W. G. Hanford and W. H. Holloway, of Springfield, are promoting a new electric railway to extend from Springfield to Delaware by way of Marysville.

Washington C. H., O.—The City Council has granted a franchise to the Springfield, Charleston, Washington C. H. & Chillicothe Traction Co. to extend the line through that place.

Cleveland, O.—The Cleveland & Southwestern Traction Co. is reported to have been asked to extend its line from North Amherst to South Amherst.

A Cleveland syndicate composed largely of men interested in the Cleveland & Southwestern Tracton Co., it is stated, are planning to build a southerly extension of that road to connect with the Ohio Central Traction Co. at Mansfield. The road will be built either from Medina to Ashland and Mansfield, or from Wellington to Ashland and Mansfield.

Lima, O.—The Lima, Findlay & Toledo Ry. Co. has been incorporated by Frank Butler, Jas. H. Griswold, Chas. H. Stocker and others, to build an electric railway from Lima to Findlay.

Toledo, O.—John Kumuer has obtained a franchise from the Lucas Co. Comrs. for his proposed road from the outskirts of the city to Ottawa Park.

The Toledo Urban & Interurban Ry. Co. has elected Geo. B. Kerper, Sr., as Pres., and A. J. Becht, Secy.-Treas. This is the holding company of the Toledo, Bowling Green & Southern Traction Co., which will operate that property under lease. The holding company will soon commence the erection of a large power-station.

Guthrie, Okla. Ter.—The Guthrie Ry. Co., with a capital of $600,000, has been granted a charter. The purpose of the company is to build an electric railway from Edmond to Guthrie, a distance of 20 miles. The company also has, under the articles of incorporation, the privilege of building telephone and telegraph lines. Incorporators. L. N. Beadles, J. R. Cottingham and Geo. M. Green, of Guthrie.

Corry, Pa.—All the bonds of the Erie-Corry Electric Ry. have been sold, and work will shortly be commenced in this city.

Connellsville, Pa.—The Pittsburg, McKeesport & Connellsville Electric Ry. Co. has secured all rights of way for extension of the West Penn lines from Leckrone to Jacob's Creek, 17½ miles. Construction will begin in the spring.

Hanover, Pa.—Town Council has directed the Borough Solicitor to frame an ordinance granting a franchise to the Hanover & McSherrystown St. Ry. Co. for its proposed extension.

Sunbury, Pa.—New York capitalists are reported to have gone over the route of the Shamokin-Sunbury Extension Railway, and have decided to begin construction work early in the spring at both ends of the line, which will be 20 miles long. The Sunbury trolley system will be absorbed by the new company.

Bellefonte, Pa.—The Bellefonte Traction Co. has been incorporated by J. C. Meyer, John Olemire, J. W. Conley, and others. The company will build a line from Milesbury, through Bellefonte, to Pennsylvania State College. The line has been surveyed. A franchise ordinance is now before Bellefonte Councils.

York, Pa.—The Chambersburg, Greencastle & Waynesboro Electric Ry. Co. will extend its line from Pen-Mar to Gettysburg.

Sumter, S. C.—The Sumter Electric Light & Ry. Co. has been incorporated, with a capital of $200,000. E. M. Beale, of Lewisburg, and J. L. Almett and H. F. Wilson, of Sumter, are the incorporators.

Keyser, W. Va.—The Keyser, Burlington & Petersburg Electric Ry. Co. is planning to begin construction work about April 1 on its proposed line. The power plant and the repair shops will be located at Keyser, W. Va. Keyser, Petersburg and nearby towns will be connected by about 42 miles of standard-gage single track. B. W. Wright, Cumberland, Md., Secy.

Sarnia, Ont.—It is said that the Grand Trunk Ry. Co. is asking for bids for the substitution of electricity for steam in the tunnel here. The plans call for the erection of a power-house on the company's property on the banks of St. Clair River.

Quebec, Que.—Application has been made to Legislature for the incorporation of the Charlevoix Electric Ry., by Mark Workman and McLea Walbank, of Montreal; Geo. Tanguay, A. Taschereau, and others, of Quebec, and Alfred Girard, of Marieville. The intention is to build the road from the present terminus of the Q. R. L. & P. Co.'s road at St. Joachim, to Murray Bay and Saguenay River, at or near Tadonsac.

RAILROADS.

Notes Arranged Alphabetically by States.

Brewton Ala.—A certificate of the incorporation of the Pensacola, Alabama & Western R. R. Co. has been filed, with a capital of $25,000. Headquarters to be at Brewton. The company is to build, maintain and operate a railroad for the transportation of freight and passengers between Pensacola, Fla., and Memphis, Tenn., and in Alabama and Mississippi. Incorporators: J. E. Stillman, W. S. Keyser and others.

Birmingham, Ala.—It is stated that the Atlantic & Birmingham Ry. (Alex Bonnyman, Supt., Brunswick, Ga.) is to be extended from its present terminus at Montezuma to Birmingham, a distance of 235 miles.

Garland, Ark.—The Garland Western R. R. Co. is stated to have petitioned the Bd. of R. R. Incorporation for a right to build a branch from its main line in Garland County to the race track at Hot Springs, about 1¼ miles in length.

Montevista, Colo.—The Montevista & North-Eastern R. R. Co. is reported incorporated, with a capital of $500,000. Two branches are to be built. One is to run from Montevista in a southeasterly direction through Rio Grande, Costilla, Saguache, Custer, Huerfano and Pueblo Counties to Pueblo. The other to commence at Montevista and run in a southwesterly direction through Rio Grande, Conejos, Archuleta and La Plata Counties to Durango. Directors: Chas. S. Fassett, D. J. Elliott, W. J. Clark, and others, of Montevista, and W. W. Reilly and C. H. Redmond, of Denver.

Danbury, Conn.—Press reports state that engineers of the New York Central R. R. Co. (H. Fernstrom, Ch. Engr., New York, N. Y.) are making surveys in this State for the purpose of finding a suitable route for the connecting link between the Harlem Division and the Boston & Albany road at Springfield.

Montezuma, Ga.—The Atlantic & Birmingham R. R. Co. is reported to be about to take steps for the extension of the road from Montezuma, the northwestern terminus, on through Georgia to Birmingham, a distance of about 250 miles.

Mansfield, La.—See "New Industrial Plants."

Hattiesburg, Miss.—The Mississippi Central R. R. Co. (M. H. McCabe, Supt., Hattiesburg,) is reported to be going over proposed routes between Silver Creek and Monticello to determine the route to be taken for an extension of 26 miles; work will commence as soon as the engineer makes his report.

**Kansas City, Mo.*—The contract for building the second track of the Union Pacific R. R. bet. Kansas City and Topeka, Kan., is stated to have been awarded to W. C. Bradbury, of Denver, Colo. He will build 67 miles of track, converting the present single track to a double-track system.

Springfield, Mo.—The Missouri Pacific R. R. (H. Rohwer, Ch. Engr., St. Louis) is reported to have commenced grading at Springfield for an extension from that place to some point on White River road. The construction at present consists of but one mile of roadbed, but there are two corps of surveyors at work, and the line is to be pushed south in the early spring.

Orange, N. J.—Plans have been prepared by the Lackawanna R. R. Co., and are now on file in the office of L. Bush, Ch. Engr., Hoboken, for the elevation of its grade crossings through Orange, for the erection of passenger stations at Orange proper and at Highland Ave., to replace the present structures, and for several other material improvements in that city. The entire work will cost about $1,728,000.

New York, N. Y.—Press reports state that the New York, New Haven & Hartford R. R. Co. (C. M. Ingersoll, Ch. Engr., New Haven, Conn.) has asked for bids for the construction of new tracks in connection with the improvement of the line from New Rochelle to the Harlem River. The total cost of the improvement is $8,000,000 and includes making this line an electric railway of 6 tracks, eliminating all grade crossings and erecting roller lift bridges over Bronx and Pelham Rivers. The cost of the work for which the bids are now asked will amount to about $5,000,000.

Mechanicville, N. Y.—The Delaware & Hudson R. R. Co. (Jas. Martin, Ch. Engr., Albany) is reported to have commenced surveying a route from the State Line to Mechanicville, a distance of about 40 miles.

Lorain, O.—It is stated that the Lake Erie & Pittsburg R. R. Co. is to construct a line from Lorain to Olmsted Falls, Cleveland, Berea, Streetsboro, Shalersville, Freedom, Newton Falls, Mineral Ridge, Niles, Girard, Youngstown, and Lowellville. A branch will be built from Youngstown to Warren.

Oklahoma, Okla. Ter.—Officials of the Denver, Enid & Gulf R. R. Co. (J. Overholt, of Enid, Okla., Gen. Supt.), now operating between Enid and Guthrie, propose extending its line south to Oklahoma City and northwest to a connection with the Union Pacific in Kansas.

Philadelphia, Pa.—The Pennsylvania R. R. Co. (W. H. Brown, Ch. Engr., Philadelphia,) is reported to be planning extensive improvements for the handling of trains at Broad St. Station, at a cost of about $500,000. The plans provide for straightening the 16 tracks entering the train shed, for extending the "throat" of the terminal beyond 20th St., a new interlocking switch plant, together with several other improvements.

Memphs, Tenn.—The Memphis, Indianola & Gulf R. R. Co. is stated to have decided to run south from Memphis between the Illinois Central R. R. and the Yazoo & Mississippi Valley to Dockery and via Yazoo City and Jackson southward to a port on the Gulf of Mexico. It is also proposed to build a branch line from Belden to Clarksdale, and other branches in the Delta country. It is reported that the first contract will be let in February for 25 miles, from Indianola to Dockery and the north, and as soon as other rights of way are secured the construction work will be pushed to completion. The preliminary surveys have been made from Memphis to the Gulf.

Somerville, Tex.—The Gulf, Colorado & Santa Fe R. R. Co. (C. F. W. Felt, Ch. Engr., Galveston) will probably expend about $300,000 in the improvement of its Somerville line.

Carrizo Springs, Tex.—The Nuedes Valley, Rio Grande & Mexico Ry. Co. has been chartered to build a railroad from Aransas Pass through the counties of Bee, McMullin, La-Salle, Dimmit, Zavalla, Maverick, Kinney and Val Verde to Del Rio, Tex., about 200 miles; capital, $300,000. Principal office to be at Carrizo Springs. S. D. Chamberlin, Pres., Ft. Worth, Tex.

Cleburne, Tex.—The State R. R. Comn. has authorized the registration of bonds of the Trinity & Brazos Valley Ry. to the amount of $1,580,000, or $20,000 per mile on 79 miles of completed railroad, extending from Cleburne, Tex., to Mexia, Tex. This line is projected from Ft. Worth to Beaumont, Tex., and it is stated that surveys will begin in a few days on an extension southeast from Mexia towards Beaumont and north from Cleburne to Ft. Worth. R. H. Baker, of Austin, Tex., Vice-Pres. and Gen. Mgr.

Seabrook, Tex.—The Galveston, Houston & Henderson R. R. Co. (J. H. Hill, Mgr., Galveston) is reported to be considering the extension of its line to Seabrook.

Spokane, Wash.—The Spokane International R. R. Co. is reported formed, with a capital of $4,000,000, by Chester M. and Alfred C. Chapin, and J. K. O. Sherwood, of New York, N. Y., to construct a branch standard gauge railroad from Spokane to the international boundary to connect with a branch to be constructed to the Canadian Pacific R. R.

****Items marked thus give the names of parties awarded contracts.***

**Winnipeg, Man.*—Foley, Larson & Stewart, of Helena, Mont., are reported to have secured the contract for the rock-work in connection with the double-tracking of the Canadian Pacific R. R. from Winnipeg to Ft. William.

Mexico City, Mex.—Press reports state that the surveyors of the Mexican Central R. R. (L. Kingman, Ch. Engr., Mexico City) have completed an overland trip from Mexico City to the port of Tuxpam, on the Gulf of Mexico, with a view to determining the most practical route for the proposed port line of the Mexican Central to be built between Mexico City and Tampico by way of Tuxpam. It is estimated that the road will cost about $17,000,000.

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

San Bernardino, Cal.—The City Trus. are contemplating the erection of a city hall at 4th and D Sts., at a cost of about $50,000.

Fresno, Cal.—The following are the bids opened on Jan. 19, by the Superv. Archt., Treas. Dept., Washington, D. C., for the construction of the U. S. Post Office and Court House at Fresno, not including heating apparatus, elevator, electric conduits or wiring: C. H. Lindgren, Fresno, $134,234; Frank Rehon, Fresno, $165,000 and Hastie & Dugan, Seattle, Wash., $137,285.

Greeley, Colo.—The City Council has taken preliminary steps toward the construction of a new city building at a cost of $20,000 on the site of the old city hall, and the question will be submitted to the taxpayers at the spring election.

Washington, D. C.—Bids will be received by Elliott Woods, Supt. U. S. Capitol and Grounds, on Feb. 4, for excavations incident to the construction of an office building for the U. S. Senate, as advertised in The Engineering Record.

Chicago, Ill.—Dr. Emil G. Beck, it is stated, has purchased a site at 1222 N. Clark St. and intends erecting a 3-story hospital, 60x120 ft., at a cost of $80,000.

The Co. Bd. is said to be considering the erection of a new county building at a cost of about $3,000,000 and the question of issuing bonds to this amount may be submitted to the citizens at an election in the fall.

Hammond, Ind.—Bids will be received by the Superv. Archt., Treas. Dept., Washington, D. C., Mar. 13, for the construction of the U. S. Post Office and Court House at Hammond, as advertised in The Engineering Record.

Peru, Ind.—It is reported that the erection of a new court house at a probable cost of $300,000 is under consideration.

Indianapolis, Ind.—It is reported that the Legislature has reported favorably on the $315,000 appropriation for the erection of a new Deaf and Dumb Institute Bldg.

**Denison, Ia.*—Marxen & Rohahr, it is reported, have received the contract for the dome and marble work in the new court house here, at about $20,850, and the contract for the electric wiring to the Western Electric Co., at $1,596. The contract for the plumbing and heating has also been awarded.

Oskaloosa, Ia.—The citizens are said to be in favor of erecting a city hall at a cost of about $40,000.

Vinton, Ia.—The Bd. of Superv. has accepted plans for a 3-story stone fireproof court house, 112x77 ft., which is to be erected at a cost of about $90,000.

**Louisville, Ky.*—The following are reported to be the bids received Jan. 16, for erecting an armory: (*a*), stone; (*b*), stone and brick; (c), pressed gray brick; (d), pressed red brick: Ronnel Bros., Louisville, *a*, $366,000; *o*, $350,000; *c*, $357,438; *d*, $347,500. Time of completion, 285 days. J. T. Wilson, Richmond, Va., *a*, $385,609; *b*, $376,609; *c*, $384,100; *d*, $379,309. Time of completion, 300 days. Paducah Constr. Co., *a*, $379,092; *b*, $368,862; *c*, $362,183; *d*, $357,381. Time of completion, 286 days. Herman Probst, Louisville, *a*, $399,973; *b*, $386,374; *c*, $392,959; *d*, $390,219. Time of completion, 350 days. Caldwell & Drake, Columbus, Ind., *a*, $348,511; *b*, $324,440; *c*, $338,411; *d*, $335,311. Time of completion 197 days. A. T. Withrow & Co., Charlestown, W. Va., *a*, $373,000; *b*, $364,000; *c*, $359,000; *d*, $363,000. Time of completion, 275 days. M. T. Lewman & Co., Louisville, submitted a bid for stone only at $397,000. The bids submitted called for tile fireproofing and the Fiscal Court decided to substitute reinforced concrete fireproofing and requested the bidders to revise their bids. Caldwell & Drake, of Columbus, Ind., secured the contract on the revised bid, at $297,263, the building to be of gray brick with stone rtimming.

New Orleans, La.—Favrot & Livandais, 839 Gravier St., are preparing plans for the Senses Hospital to be erected on Basin St. and Elk Pl., to cost $125,000.

Baltimore, Md.—Mayor Timanus has signed the ordinance appropriating $24,000 for a fire engine house and equipment at Pratt and Greene Sts.

The Centre Market Comn., it is reported, has accepted plans prepared by Simonson & Pietsch, of Baltimore, for the wholesale fish market, which is to be a 2-story building and is to cost about $100,000.

The Comn. has authorized the same archts. to prepare plans next for the wholesale produce market.

Salem, Mass.—The Co. Comrs. have purchased a site on Federal and Bridge Sts. on which to erect the proposed new court house, which is to cost about $250,000.

Adrian, Mich.—Bids will be received Mar. 2, by Jas. Knox Taylor, Superv. Archt. Treas. Dept., Washington, D. C., for constructing U. S. Post Office here.

Muskegon, Mich.—Bids will be received Mar. 8, by Jas. Knox Taylor, Superv. Archt., Treas. Dept., Washington, D. C., for constructing U. S. Post Office and Court House here.

Minneapolis, Minn.—The Lakewood Cemetery Assoc., it is reported, intends erecting a chapel at the entrance at 36th St. and Hennepin Ave., at a cost of about $35,000.

Jackson, Miss.—The directors of the Mississippi Methodist Orphanage, located at Water Valley, it is reported, are contemplating erecting near this city a building at a cost of about $25,000.

Greenwood, Miss.—Bids will be received Mar. 6, by the Bd. Co. Supervs., for erecting a court house; bids will also be received on same date for steam heating, plumbing and electric wiring said court house. C. W. Crockett, Clk.

Gulfport, Miss.—See "Sewerage and Sewage Disposal."

Moberly, Mo.—Bids will be received by the Superv. Archt., Treas. Dept., Washington, D. C., on Mar. 14, for the construction (including plumbing, heating apparatus, electric wiring and conduits) U. S. Post Office at Moberly, as advertised in The Engineering Record.

Kansas City, Mo.—The Sisters of St. Mary have completed plans for a $70,000 hospital to be erected at 28th and Main Sts.

Ft. Assinniboine, Mont. —Bids are wanted Feb. 21 for plumbing and heating new guardhouse and for plumbing double N. C. S. O. quarters at this post. Address Capt. J. B. McDonald, Constructing Q. M.

South Omaha, Neb.—A site has been purchased on 25th and G Sts., on which it is proposed erecting a hospital, to cost about $25,000. Address President King.

Ft. Slocum, N. Y.—Bids are wanted Feb. 8 for constructing brick double barrack at this post. Address W. J. Davis, Q. M.

Westfield, N. Y.—The Trus. of the Patterson Library, it is stated, have accepted plans prepared by E. E. Joralemon, Gluck Bldg., Niagara Falls, for the Patterson Library which is to be erected this summer of marble and brick, at a cost of about $60,000.

New York, N. Y.—An ordinance has been signed by the Mayor appropriating $25,000 corporate stock for the purpose of rebuilding the kitchen and laundry on Hart's Island, under the jurisdiction of the Comrs. of Correction.

A bill has passed the Senate authorizing the appropriating of corporate stock amounting to $1,250,000 to meet the expenses of constructing an extension to the Metropolitan Museum of Art. It is proposed to erect a wing to the 5th Ave. side of the museum to be 350 ft. long.

Geneva, N. Y.—Improvements to the armory at a probable cost of $50,000 are reported under consideration.

Mansfield, O.—A site has been selected on W. 3d St., on which it is proposed erecting the Carnegie Library, $35,000 having been donated.

Findlay, O.—Bids will be received by the Superv. Archt., Treas. Dept., Washington, D. C., on Mar. 7, for constructing of U. S. Post Office at Findley, as advertised in The Engineering Record.

Cincinnati, O.—Bids will be received Feb. 15 by the Bd. Trus., Memorial Assoc., for furnishing material and erecting a soldiers' and sailors' memorial building, including excav., concrete foundations, brick work, asphalt roofing, fireproofing, tile and sheet metal work, iron and steel work, plumbing, gas-piping, electrical work, ventilating, heating, etc. Saml. Hannaford & Sons, Archts., Hulbert Blk.; Aaron McNeill, Secy. According to press reports, cost, including ground, will be about $300,000.

Lorain, O.—The City Council on Jan. 18 passed a resolution authorizing Vice-Mayor Newson to name a committee of 7, five citizens and two members of the Council, to go to work on the idea of having a combination city hall and interurban railway station in the public square, and to have plans drawn, and estimates submitted.

Pittsburg, Pa.—The Com. of Pub. Safety have passed ordinances providing for the installaton of a new boiler in the Municipal Hospital and the appropriating of $12,500 for a machine shop and power house for the use of the Fire Dept. in the 13th Ward.

Philadelphia, Pa.—The Trus. of the Free Library have commissioned Field & Medary, 1414 S. Penn Sq., to prepare plans for a 2-story brick and terra cotta building to be erected at 17th and Spring Garden Sts.

Harrisburg, Pa.—The State leaders are said to be in favor of a bill which has been introduced in the Legislature appropriating $60,000 for the erection of a State building and the expenses of the commission to the Lewis and Clark Exposition, to be held in Portland, Ore.

Reading, Pa.—A committee has been appointed to secure plans and specifications for the enlargement of the Homeopathic Hospital and the erection of a Nurses' Home. It is expected to begin work on the improvements early in the spring.

Yankton, S. D.—The following are the 3 lowest bids opened on Jan. 18, by the Superv. Archt., Treas. Dept., Washington, D. C., for the low pressure steam heating apparatus for the U. S. Post Office at Yankton: Pond & Hasey, Minneapolis, Minn., $2,400; Hess & Rau, Watertown, $2,200; Symes-Powers Co., Sioux Falls, $2,485.

Chattanooga, Tenn.—See "Sewerage and Sewage Disposal."

**Knoxville, Tenn.*—A building permit has been granted to the Tennessee Medical College for a hospital which is to be erected on Cleveland St. It is to be 2 stories high, of brick, 140x150 ft., and cost about $30,000. Leon Beaver, French & Roberts Bldg., is the archt.; Thomas & Turner are the builders.

**Taylor, Tex.*—The contract to erect the city hall, it is reported, has been awarded to J. C. McKnight, of Hallettsville, Tex., at about $22,000. Henry Struve, of Taylor, is the archt.

**Dallas, Tex.*—L. L. Bristol, Bldg. Inspector, writes that contracts for the erection of an auditorium at the State Fair Grounds (bids opened Jan. 16) have been awarded as follows: General construction to Knight & Kenyon, of Dallas, for $54,500 and for the steel work to the Missouri Valley Bridge & Iron Co., of Leavenworth, Kan., for $15,350. The building will be completed Aug. 1, 1905. The materials to be used in construction are concrete, reinforced concrete, cement blocks, and steel. It will be practically fireproof.

Richmond, Va.—J. E. Tyler is said to be interested in the project to erect a bath-house at a cost of about $15,000, the city to furnish the site, and to assume the cost of maintenance.

Baraboo, Wis.—Plans prepared by A. C. Clas, of Milwaukee, for the proposed $100,000 court house for Sauk County have been accepted.

Ellsworth, Wis.—Bids will be received Feb. 23 by the Co. Clk. for furnishing material and erecting a court house, remodeling county office building and erecting a fireproof jail; bids for plumbing, heating, electrical work to be submitted separately. Estimated cost, $85,000. Buechner & Orth, Archts., St. Paul, Minn.

Toronto, Ont.—Manager J. O. Orr, of the Canadian National Exhibition, has submitted to the Bd. of Aldermen plans for the new Art Gallery, which, if constructed of concrete, is to cost $27,000, or of brick, $29,000.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

Pine Bluff, Ark.—The officials of the St. Louis, Iron Mountain & Southern Ry. have submitted to the City Council 2 propositions, with certain conditions, for the erection of a passenger station in this city; one providing for the erection of a union station with the Cotton Belt R. R., at a cost of about $75,000, and the other for the erection of a station for its own use at a cost of about $20,000. H. Rohwer, Ch. Engr., St. Louis, Mo.

**San Francisco, Cal.*—Herbert E. Law, it is reported, has awarded the general contract for the building to be erected on the site of the old Bishop Bldg., on Market St., to the Hawaiian Commercial Co., and the contract for the steel work to Milliken Bros., of New York, N. Y., the total cost to be about $1,000,000.

*Reid Bros., Claus Spreckels Bldg., archt. for the Fairmont Bldg., it is stated, has awarded contracts for furnishing material and labor for the erection of said building as follows: Carpenter work to McPhee Co., at $88,655; metal work to Patrick Noble, at $6,000; plastering to Smyth Bros., at $54,700; two contracts to the Western Expanded Metal Fireproofing Co., at $23,419 and $108,584.

Santa Rosa, Cal.—The Masonic fraternity, of this city, intends erecting a 3-story building at 4th and D Sts., at a cost of about $70,000.

Denver, Colo.—Wm. R. Leonard, it is stated, will erect a 4-story store and hotel on 6th and Welton Sts., at a cost of about $40,000. John J. Huddart, 42 Bank Blk., is the archt.

Gunnison, Colo.—The shops of the Denver & Rio Grande R. R. Co., in this city, have been destroyed by fire. E. J. Yard, Ch. Engr., Denver.

Washington, D. C.—Frank A. Munsey, of New York, N. Y., has purchased the site at Pennsylvania Ave. and 13th St., and will erect an 11-story building for the Washington Times.

Tampa, Fla.—The Seaboard Air Line R. R. (W. W. Gwathmey, Jr., Ch. Engr., Portsmouth, Va.), it is reported, intends erecting a passenger station in this city at a cost of about $25,000.

**Boise, Idaho.*—Michels & Weber, of Boise, it is reported, have received the contract to erect the Overland Block at 8th and Main Sts., at about $77,400.

Chicago, Ill.—J. K. Sebree is said to be contemplating the erection of an 18-story hotel at Dearborn and Monroe Sts.

The Free Methodist Publishing House, it is stated, intends erecting at Ogden Boule. and Washtenaw Ave. a 3-story brick and stone building, 112x280 ft., to cost about $30,000. Harold M. Hansen, 88 La Salle St., is the archt.

Cobe & McKinnon will improve the northeast corner of Indiana Ave. and 18th St., with a warehouse and stables, which have been leased in advance of construction to Rothschild & Co. The building will be 4 stories high, 121x178 ft., of brick and mill construction, and cost $100,000.

The Rubber Paint Co., whose plant was recently destroyed by fire, will erect a new building at 148-154 W. Van Buren St. It will be 4 stories high, of mill construction, 100x119 ft., and cost $60,000.

Monmouth, Ill.—It is reported that a stock company is being formed to erect a hotel, at a cost of about $40,000. H. B. Smith may be able to give information.

Jacksonville, Ill.—The Wabash R. R. Co. will erect a $10,000 depot at this place.

Indianapolis, Ind.—W. J. Holliday & Co. will erect a 5-story brick and stone warehouse at Missouri and Georgia Sts., estimated to cost $40,000.

**Des Moines, Ia.*—W. F. Mitchell & Co., 315 9th St., it is reported, have received the contract to erect the 3-story pressed brick, 62x132-ft. Lederer & Strauss Bldg. at 6th and Plum Sts., at about $28,000. Hallett & Rawson, 615 Walnut St., are the archts.

Louisville, Ky.—A company, it is stated, is about to be formed for the purpose of erecting an auditorium at a cost of about $70,000. Jas. B. Camp, it is reported, is interested in the company. Brinton B. Davis, of Paducah, is the archt.

A building permit has been granted to the Louisville & Nashville R. R. for an 11-story steel, stone and brick, 200x60-ft. office building which is to be erected at Bway. and 10th St., at a cost of about $300,000.

New Orleans, La.—The building of the Young Men's Hebrew Assoc., it is reported, has been destroyed by fire.

Lewiston, Me.—Frank B. Philbrick, of Waterville, Treas. of the Good Will Homes Assoc., it is reported, has announced that the Chas. E. Moody Memorial Building, which was destroyed by fire on Dec. 31, is to be rebuilt. The cost of the destroyed building was $28,000.

**Boston, Mass.*—Plans have been filed for a 3-story brick office building, 61x40 ft., to be located at 1260 Columbia Road. Builder, C. A. Dodge & Co., 8 Beacon St.; Architect, Herbert S. Kimball, 101 Tremont St.

Hancock, Mich.—A committee of which Henry Baer is a member, is considering the erection of a 3-story building, 50x100 ft., for the Lodge of Elks, at Reservation and Hancocks Sts., at a cost of about $30,000. H. S. Liebert, Archt., of Hancock, may be able to give further information.

Mt. Clemens, Mich.—Albert Denmark, of Pittsburg, Pa., it is reported, has purchased a site on Lake St. Clair, on which he proposes erecting a $20,000 hotel.

Princeton, Minn.—It is reported that Morneau Bros. will erect a new hotel to replace the one destroyed by fire. Probable cost, $27,000.

**St. Paul, Minn.*—A $450,000 9-story reinforced concrete building is to be erected at 2d and Jackson Sts., for the Farwell-Ozman-Kirk Co. Contractor, Geo. J. Grant, 61 E. 9th St.

Hannibal, Mo.—The Hannibal Hotel Co. has been organized to erect a $65,000 hotel. Address Chas. H. Northan.

Orange, N. J.—See "Railroads."

Newark, N. J.—A building permit has been issued for a 5-story brick warehouse and storage plant to be erected at 132 Mulberry St., at an estimated cost of $24,231. M. O'Connor, owner.

New York, N. Y.—The 5-story bank and office building at 31 Pine St. was destroyed by fire on Jan. 22.

Charlotte, N. C.—Plans are being received by the Central Hotel Co., for the remodeling or rebuilding of the Central Hotel. The erection of a 7-story building is contemplated.

**Toledo, O.*—A. Bentley & Son, it is reported, have received the contract to erect a commercial building for J. W. Close, on Superior St., at a cost of about $25,000.

Lorain, O.—See "Public Buildings."

Marion, O.—The members of the Canby Lodge, No. 51, Knights of Pythias, are said to be contemplating the erection of a 3 or 4-story building at a cost of about $25,000.

Pittsburg, Pa.—The Commonwealth Realty & Constr. Co. will erect at 412 Grant St. a 14-story office building and have commissioned E. J. Schellentrager, 309 4th Ave., to prepare plans for the building.

The Hotel Annex Co., Glenn T. Braden, Pres., is said to be contemplating the erection of a 14-story hotel on 607 Penn Ave., to be known as Hotel Annex.

Philadelphia, Pa.—Local press reports state that Wm. Steele & Sons, 1600 Arch St., will receive subestimates until Feb. 2 on the 7-story and basement granite and terra cotta building which is to be erected at 1012 Walnut St., for the Stephano Bros. Cigarette Co.

Memphis, Tenn.—Plans have been completed by Fred H. Eely & Co. for a $20,000 building which is to be erected by the Memphis Natatorium Co., on Linden St.

Houston, Tex.—The Lodge of Elks, No. 151, has decided to erect a club house at a cost of about $50,000. F. W. Heitmann is Chmn. Com. on Bldgs.

Spokane, Wash.—The directors of the Salvation Army are considering the erection of a 5-story building here at a cost of about $75,000. Commander Thos. B. Coombs, of Toronto, Ont., it is reported, is in charge of the Army work in this State.

Milwaukee, Wis.—Plans have been completed for a 5-story brick office and warehouse which is to be erected by the Abel & Bach Co., trunk mfgrs., at 10th St. and St. Paul Ave. E. J. Bach is Pres.

An 8-story brick and stone Y. M. C. A. office building is to be erected on 4th St. and Grand Ave., at a cost of $350,000. C. B. Willis, Gen. Secy.

The Joy Bros. Co., owners of the property at 205 Water St., it is stated, are having plans prepared for a 3-story brick and stone building, which they intend erecting at a cost of $100,000.

Plans are being prepared for a 4-story and basement brick and stone addition which the A. Geo. Schultz Co. intends erecting to its

**Items marked thus give the names of parties awarded contracts.*

nt at 5th and Clybourn Sts., at a cost about $75,000.

H. Messmer & Sons, 473 E. Water St., it is ted, are preparing plans for remodeling the James Hotel, at a cost of about $18,000.

John Roth, Jr., 307 Grand Ave., is pre- ring plans for a 4-story business block and t building which is to be erected for Otto homberg, on 4th and Sycamore Sts., at a st of $20,000.

Madison, Wis.—A Woman's Club House is be erected here at a cost of $30,000. Mrs. s. Gibson is interested in the project.

Toronto, Ont.—A building permit has been anted to Mark Fisher & Sons for a 5-story ick and stone office building to be erected 84 Bay St., at a cost of $30,000.

NEW YORK, N. Y.

31st St and 2d Ave, 6-story br and stone ores and tenemts; c, $43,000; o, Thos Lar- n; a, Edward A Meyers.

415 E 75th St, 6-story br and stone store d tenemts; c, $26,500; o, David Lenten; a, eo F Pelham.

92d St and 2d Ave, 2 6-story br and stone ores and tenemts; total c, $120,000; o, ouis Levin; a, Geo F Pelham.

103d St and 2d Ave, 6 6-story br and stone tores and tenemts; total c, $240,000; o, iillman & Golding; a, Bernstein & Bernstein.

240 E 110th St, 2 6-story br and stone tores and tenemts; total c, $80,000; o, Louis ewenhof; a, Sass & Smallheiser.

2d Ave and 126th St, 2-story stone and rame dancing pavilion; c, $25,000; o, Peter H Jackson estate; a, F R & A L MacLen- an.

8th Ave and 148 St, 6-story br and stone tores and tenemts; c, $60,000; o, Abraham ilverson; a, Geo F Pelham.

337 E 122d St, 6-story br and stone store nd tenemt; c, $20,000; o, Raphael Kurzrok; , Horenburger & Straub.

90th St and 3d Ave, 2-story br and stone ottling house; c, $40,000; o, Jacob Ruppert; , Julius Kastner.

CHURCHES AND DWELLINGS.

Notes Arranged Alphabetically by States.

Texarkana, Ark.—It is reported that the nembers of the Presbyterian Church are con- emplating the erection of a new edifice at a ost of $25,000. Address Pastor.

Los Angeles, Cal.—A permit has been is- sued for the erection of a residence for Wes- ey Clark, on Wesley Drive, bet. Pico and 10th Sts., to cost $30,000. Archts., Hudson & Munsell, Los Angeles.

Athens, Ga.—The Presbyterian Church is to be remodeled at a cost of $35,000.

Chicago, Ill.—Huehl & Schmid, 163 Randolph St., have designed an apartment house, to be built for Louis Ehrhardt on Barry Ave. between N. Clark St. and Evanston Ave. It will be 3 stories, 100x176 ft., and cost $80,000.

H. H. Waterman, 218 La Salle St., is the architect of a 2-story apartment building, 200x160 ft., to be built at 55th St. and Ellis Ave., for T. E. Wells, at a cost of $100,000.

Centerville, Ia.—Bids are wanted Feb. 1 for erecting an edifice for First M. E. Church. J. P. Eisentraut, Archt., Sioux City.

**Junction City, Kan.*—Jacob J. Olson & Son, of Muskegon, Mich., it is stated, has secured the contract to erect a stone R. C. Church at a cost of about $20,000.

Baltimore, Md.—Wm. J. Miller, it is stated, is forming a company for the purpose of erecting a 12-story apartment house at Eutaw Pl. and Mosher St., for which plans have been prepared.

Grand Rapids, Mich.—W. G. & F. S. Robinson, Houseman Blk., it is stated, are preparing plans for an apartment house to be erected by the Majestic Theater Assoc., on N. Park St. It is to be a 6-story brick and stone structure and to cost about $25,000.

Freeport, Minn.—It is stated that Parkinson & Dockendorf, of La Crosse, Wis., have prepared plans for an edifice for the R. C. Church, which is to cost about $35,000.

Kansas City, Mo.—Hans Dierks, Pres. of the Dierks Lumber Co., it is stated, will erect a residence at a cost of $25,000. J. G. Braecklein, 211 E. 14th St., is the archt.

Syracuse, N. Y.—The Polish Catholic Church congregation, it is reported, is contemplating the erection of a new edifice, at a cost of $30,000. Rev. Francis Russin, Pastor.

**Cleveland, O.*—Architect E. E. Smith, Williamson Bldg., it is stated, has awarded the general contract, including mason-work, iron and steel, fireproofing and tile work, for the new 7-story apartment building to be erected at Euclid and Genesee Aves., to J. A. Reaugh & Son, Garfield Bldg., who have sublet the contract for iron and steel work to the National Iron and Wire Co. The building will cost about $100,000.

Cincinnati, O.—Chas. Mayer, it is stated, will erect a concrete apartment house at St. Ledger Pl. and Gilbert and Woodburn Aves., estimated to cost $250,000. Philip G. Pfeiffer, 10 E. McMillan St., is the archt.

Toledo, O.—Dr. F. W. Alter, it is reported, will erect a flat at the northwest corner of Jefferson Ave. and 21st St., to cost $25,000, and Fred. A. Lawrence a flat at the southwest corner of Jefferson Ave. and 21st St., to cost $30,000.

Latrobe, Pa.—The Holy Family R. C. Church, it is reported, has decided to erect an edifice, at a cost of $100,000. Rev. McCullough, pastor.

York, Pa.—Chas. A. Keyworth, of York, is preparing plans for a suburban residence for C. Robt. Kopp, of this place, to be built in the spring; estimated cost, $30,000.

Chattanooga, Tenn.—Dwight P. Montague, it is stated, will erect a residence on East Terrace, to cost $20,000.

Fredericksburg, Tex.—It is stated that bids are wanted Feb. 1 for erecting a stone church here. For further information, apply to Rev. F. C. Neisens.

NEW YORK, N. Y.

65th St and 1st Ave, 4 6-story br and stone tenemts; total c, $280,000; o, The City and Suburban Homes Co; a, Jas E Ware & Son.

112th St and 2d Ave, 2 6-story br and stone tenemts; total c, $80,000; o, C & H Friedman; a, Bernstein & Bernstein.

109th St and B'way, 6-story br and stone tenemt; c, $52,000; o, Kleinfeld & Englesberg; a, Eugene J Stern.

Amsterdam Ave and 121st St, 6-story br and stone tenemt; c, $150,000; o, I Ruth; a, John Houser.

134th St and Amsterdam Ave, 5 5-story br and stone tenemts; total c, $175,000; o, Rosenthal & Levy; a, Glasser & Ebert.

148th St and 8th Ave, 2 5-story br and stone tenemts; total c, $76,000; o, Abraham Cohen; a, Geo F Pelham.

8th Ave and 148th St, 2 5-story br and stone tenemts; total c, $76,000; o, Abraham Silverson; a, Geo F Pelham.

7th Ave and 148th St, 2 5-story br and stone tenemts; total c, $70,000; o, Jos McConnell; a, John Hauser.

Riverside Drive and 127th St, 6-story br and stone tenemt; c, $175,000; o, Calvert Constr Co; a, L A Goldstone.

158th St and Jackson Ave, 2 6-story br tenemts; total c, $100,000; o, Max Ratz and Ludwig Polacek; a, John Hauser.

Arthur Ave and Kinsbridge Rd, 2 4-story br tenemts; total c, $30,000; o, Jos Faiella; a, Chas S Clark.

Trinity Ave and 164th St, 2 5-story br tenemts; total cost, $85,000; o, John Boyland; a, Harry T Howell.

447 E 122d St, 6-story br and stone tenemt; c, $46,000; o, Chas H Wallas; a, Edward A Meyers.

SCHOOLS.

Notes Arranged Alphabetically by States.

**Birmingham, Ala.*—The Bd. of Trus. Educ. has decided to have the high school built of pressed brick instead of common brick, the material on which the contract was previously awarded. The contract for the pressed brick, it is reported, has been awarded to Thos. Poull & Co., of Birmingham, at $91,400.

The Secy. of the Bd. of Educ. has been authorized to receive plans and specifications for 2 elementary schools, the cost of each not to exceed $20,000.

Washington Barracks, D. C.—Bids will be received by Capt. John Stephen Sewell, Corps Engrs., U. S. A., on Feb. 23, for c. i. or filled sheet copper window frames and sash for buildings, Army War College, as advertised in The Engineering Record.

Washington, D. C.—The following are the bids opened on Jan. 21, by the Dist. Comrs., for erecting the John W. Ross School, an 8-room building on Columbia Heights: Jas. M. Dunn, $43,000, and Gleeson & Humphrey, $41,950.

Valdosta, Ga.—Bids will be received Feb. 8 by the Bd. Educ. for erecting a high school, to cost about $25,000. T. W. Smith & Co., Archts., Columbus; R. B. Daniel, Supt.

Oak Park, Ill.—The citizens have voted in favor of issuing $160,000 bonds to erect a high school at Ontario St. and East Ave.

Barrington, Ill.—Turnbull & Jones, of Elgin, have prepared plans for a high school which is to be erected at a cost of $23,000.

Lafayette, Ind.—The members of the Lutheran Church intend erecting a college in this city, to cost about $50,000.

Hope, Ind.—The School Bd., it is stated, is considering the erection of a school at a cost of $15,000.

Brazil, Ind.—It is reported that the School Bd. is contemplating the issue of $60,000 bonds for the erection of new schools.

Baton Rouge, La.—See "Water."

Baltimore, Md.—Bids will be received Feb. 8, by the Bd. of Awards for erecting Eastern high school on B'way and North Ave. Plans and specifications will be furnished on deposit of $100. Edw. D. Preston, Inspector of Bldgs.

Springfield, Mass.—Bids will be received Feb. 10 by the City Clk. for erecting a technical high school, not including heating, ventilating, plumbing and electric work; appropriation, $225,000. E. C. & G. C. Gardner, Archts., 33 Lyman St.; W. A. Ford, Chmn. City Property Com.

Holyoke, Mass.—The erection of an 8-room addition to Sargeant St. School is reported under consideration.

**Fall River, Mass.*—J. F. Johnston & Co., 371 Central St., it is reported, has received the contract for heating and ventilating the Eastern Ave. School at $4,057, and the contract for plumbing in same at $3,299.

Detroit, Mich.—It is reported that a $25,000 addition is to be erected in the spring to the St. Elizabeth R. C. parochial school at McDougall and Canfield Sts. Rev. A. P. Ternes, pastor.

St. Louis, Mo.—The Bd. of Educ., it is reported, has adopted plans for a $205,000 building to replace Shields School. W. B. Uttner, Bldg. Comr.

Orange, N. J.—Local press reports state that the Bd. of Educ. has authorized bids to be received until Feb. 14 for erecting a brick school, the cost not to exceed $85,000.

Brooklyn, N. Y.—Bids will be received Feb. 6 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for erecting, including plumbing and drainage, School No. 109.

Gloversville, N. Y.—The erection of a $100,000 high school is under consideration.

Syracuse, N. Y.—The Trus. of the Syracuse Univ., it is stated, will erect a new laboratory with the $200,000 bequest received from the John Lyman estate. It will be located east of the Lyman C. Smith College of Applied Science and will contain the departments of biology, botany, physiology and geology, and will be called the John Lyman Laboratory of Natural History.

Buffalo, N. Y.—Deputy Bldg. Comr. Rumrill has submitted to the Aldermanic Com. on Schools preliminary plans for a 10-room school which it is proposed erecting at Clinton and Weiss Sts. The cost of the building, if a hot-air system of heating is used, is estimated at $26,000; with steam-heating $5,000 additional, and with steel ceilings $1,200 additional.

New York, N. Y.—Plans have been filed for a 5-story brick extension to 5-story brick and stone public school, to be erected at St. Nicholas Ave. and 117th St. for the City of New York, at a cost of $90,000. C. B. J. Snyder, Archt., 500 Park Ave.

*The following are the bids opened on Jan. 16, by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for installing ventilating and heating apparatus in school No. 41, Bronx Boro.: Rossman & Bracken Co., $16,600; E. Rutzler Co., $15,665; N. Y. Steam Fitting Co., $18,401; Frank Dobson, $15,614; Walker & Chambers, 50 E. 20th St., $14,748 (awarded contract), and Geo. A. Suter, $14,772.

Bids will be received Feb. 6 by C. B. J. Snyder, Supt. School Bldgs., for erecting School No. 10, Boro. Bronx; also for erecting addition to School No. 10, and installing ventilating and heating apparatus in addition to School No. 104, Boro. Manhattan.

**New Brighton, S. I., N. Y.*—The following are the bids opened on Jan. 16, by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for installing ventilating and heating apparatus in School No. 12,, Richmond Boro.: Geo. A. Suter, $11,240; E. Rutzler Co., $11,031; N. Y. Steam Fitting Co., $11,869; Frank Dobson, $11,646; Rossman & Bracken Co., $11,000; Evans, Almirall & Co., $11,397 and Walker & Chambers, 50 E. 20th St., New York, $10,249 (awarded contract).

Bids will be received Feb. 6 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for erecting fire escapes and making alterations to Schools Nos. 1, 11, 15 and 17, Boro. Richmond.

**Long Island City, L. I., N. Y.*—The Eagle Iron Wks., 403 E. 117th St., N. Y. City, has secured the contract for constructing fire escapes at school No. 14, Queens Boro. (bids opened Jan. 16) for $2,520.

New Rochelle, N. Y.—The Bd. of Educ. is considering the erection of a high school at a cost of about $150,000.

Scotia, N. Y.—A site has been selected on First St. on which it is proposed erecting a school at a cost of $24,000. J. C. Perham is Chmn. of the Com.

Newark, O.—A resolution has been adopted by the Bd. of Educ. authorizing the sale of $25,000 school bonds.

Delaware, O.—It is reported that a $70,000 gymnasium is to be erected at the Ohio Wesleyan Univ.

Cleveland, O.—The School Bd. is said to have under consideration the erection of 4 and possibly 5 schools, the total cost to be about $235,000.

Cincinnati, O.—The Bd. of Educ. is said to be considering the erection of a school in Avondale and 2 schools in the West End, the total cost to be about $300,000.

Alva, Okla. Ter.—Reports state that bids will be received Feb. 10 by the Bd. Trus. Woods Co. High School, for erecting a school, to cost about $32,000.

Klamath Falls, Ore.—The County Court has decided to erect a high school, at a cost of $25,000, and, it is stated, expect to award the contract for its erection at the Mar. meeting.

Columbia, S. C.—Edwards & Walter, Kendall Bldg., have about completed plans for the Laurel St. school which is to be erected at a cost of about $40,000.

San Angelo, Tex.—It has been decided to issue $20,000 bonds to erect new schools.

Ft. Worth, Tex.—The North Ft. Worth Bd. of Educ., it is stated, is considering the erection of a 3-story brick school to include the city hall, at a cost of $25,000.

Staunton, Va.—It is reported that bids will be received Feb. 15 by T. J. Collins & Son, Archts., Crowle Bldg., for erecting a brick or cement school and dormitory for Staunton Military Academy.

**Seattle, Wash.*—Robt. Brown has secured the contract for erecting the Summit School, for $45,673.

McMechen, W. Va.—Chas. D. McCarty, Reilly Bldg., Wheeling, it is reported, is preparing plans for a 15-room $55,000 brick school, which is to be erected here.

**Green Bay, Wis.*—Jos. H. Servatte, 1034 Walnut St., it is reported, has received the contract to erect the parochial school for St. Patrick parish, at about $19,492, not including heating, plumbing, etc.

Shawano, Wis.—The Indian School on the Menominee Reservation at Keshano, 8 miles north of here, it is reported, has been destroyed by fire.

Westfield, Wis.—Bids are wanted Feb. 6 for erecting addition to high school. F. W. Meinke, Clk. School Bd.

STREET CLEANING AND GARBAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Meriden, Conn.—Bids will be received Jan. 30 by the Health Com. for collecting and removing ashes and garbage twice each week, commencing Mar. 1, 1905. W. F. Bowe, Chmn.

Waterbury, Conn.—At the meeting of the Bd. of Health, Jan. 20, it was voted to call for bids for the collection and disposal of garbage for a term of one year, with the privilege of renewing it for another year at same terms; proposals to be received Feb. 20. Under the new contract the city will own plant so that hauling will be the principal item of expense.

Chicago, Ill.—Bids will be received by A. W. Blocki, Comr. of Pub. Wks., on Feb. 16 for furnishing all labor and material required for the collection, removal and disposition of garbage, refuse and ashes within the city limits, as advertised in The Engineering Record.

Davenport, Ia.—The Mississippi Valley Garbage Destroying & Fuel Co., of Davenport, is reported formed, with a capital of $100,000 by Geo. Mengel, J. A. Hanley and Chas. W. Smith. The company will manufacture coal out of garbage and slack, and contract with cities for the disposal of garbage.

Atlantic City, N. J.—Press reports state that the Sanitary Com. (Chas. W. Mathis, Chmn.) will receive bids on Feb. 13 for the collection of garbage for the next year. The present contract expires Feb. 15.

Albany, N. Y.—Bids wll be received Feb. 6 by the Bd. Contract and Supply for removing street dirt and dead animals. Isidore Wachsman, Clk.

Cleveland, O.—An ordinance is stated to have been introduced in Council authorizing the expenditure of $65,000 in enlarging, improving, equipping and furnishing the garbage plant.

Portland, Ore.—The Bd. of Health is reported to be in favor of constructing a garbage crematory.

NEW INDUSTRIAL PLANTS.

For ice plant at Vidalia, Ga., see "Power Plants, Gas and Electricity."

The Elkhart, Ind., Bridge & Iron Co. contemplates adding a 40x80-ft. forge shop, with a complete set of tools, to its plant. The company will also install an additional motor-driven air compressor, of 300 cu. ft. per minute capacity, in its riveting shop.

The Acrogen Coal Co., Paintsville, Ky., contemplates erecting a 50x100-ft brick boiler and power house, installing 600-h.p. in boilers, 400-h.p. engine and electrical power plant for mining and hauling 1,000 tons of coal per 10 hours. The company will also build a 30x70-ft carpenter, blacksmith and machine shop and install a mine fan 20 ft. in diameter. J. W. Bischoff, gen. mgr.

The Kennedy Stave & Cooperage Co., Mobile, Ala., is arranging to install a stave manufacturing plant, to be in operation in 60 or 90 days.

The Pioneer Roll Paper Co., 380 S. Los Angeles St., Los Angeles, Cal., whose plant was recently burned, is making arrangements for a 3-story and basement building, 175 ft. deep, with a power plant of about 25 h.p.

The Chattanooga, Tenn., Iron & Wire Works is figuring on having a new building erected. Current from local company will be used for power.

The Universal Mfg. Co., Winston-Salem, N. C., has rented a building and will install a 40-h.p. engine and a 60-h.p. boiler, which have not yet been ordered. A. C. Miller, secy.

Farnsworth & Wertz, Glade Spring, Va., dealers in machinery, will erect a small factory, details of which have not yet been decided.

The McKay Carriage Co., Grove City, Pa., whose plant was recently burned, contemplates erecting a cement block building, perhaps 150 ft. square. The company will require woodworking machinery, sanders, blacksmithing tools, drill presses, anvils, etc.

I. C. DeHart & Co., Woolwine, Va., will build a plant some time during the summer. Plans are not yet matured.

The National Machine Works, Sheffield & North Aves., Chicago, whose plant was recently burned, will rebuild the shop as soon as possible.

Leon Stern, Rochester, N. Y., is preparing plans for a 5-story, slow-burning factory building for the Van Bergh Silver Plate Co. The power plant will probably be of 100 to 125-h.p. capacity.

The Winslow Bros. Co., Carroll Ave., Ada & Fulton Sts., Chicago, manufacturer of ornamental iron, is having plans prepared for a new plant.

John A. Bunch, president of the People's Bank, of Harrison, Ark., is interested in a movement to erect a one-set woolen mill.

The Perry Soap Co., Helena, Mont., will erect a 2-story, 100x60-ft. building and will probably require 125 h.p. boiler capacity at 150 lb. pressure, a 25-h.p. engine, feed, hydraulic and other pumps, elevator, etc.

The Muskegon, Mich., Boiler Works will erect a new plant, but details are not yet available.

The Blanchard Machine Co., 16 Harcourt St., Boston, Mass., will erect a 2-story and basement, 60x110-ft. building of mill construction, in Cambridge. For power, which will be taken from a neighboring plant, a 60-h.p. 220-volt direct-current belted generator, two motors of 20 h.p. and one of 10 h.p. will be required. The building will be equipped with an electric traveling crane.

W. H. Gardner, Delphi, Ind., is interested in the organization of a stock company to build a mill and elevator.

The Montgomery, Ala., Lumber Mfg. Co., whose plant was recently burned, will probably erect a sash, door and blind factory and a planing mill.

Items marked thus give the names of parties awarded contracts.

Col. H. W. Rowley, secy. & treas., Billings, Mont., Water Power Co., writes that it is expected to erect a beet-sugar plant of 600 tons daily capacity during the coming year. Details have not yet been decided.

The DeSoto Lumber Co., Mansfield, La., capital, $200,000, intends to install a saw and planing mill of 75,000 to 100,000 capacity, and will probably locate in Mansfield, in which event 8 miles of road will be built. Geo. H. Byrnes, treas.

The R. E. Wood Lumber Co., Continental Trust Bldg., Baltimore, Md., has let contract for a sawmill in Carter Co., Tenn. In addition to this, the company expects to operate a large dry kiln and planing mill, plans for which have not been completed.

A permit has been granted to Appleton & Burrell, Philadelphia, to erect a 5-story, 20x 100-ft. light manufacturing building for Moses Rice. Cost, $18,000. F. M. Day & Bro., archts.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

Red Fork, Ark.—Bids are wanted Feb. 1 for about 50,000 cu. yd. levee work in Red Fork Levee Dist., near Red Fork. For information apply to A. Wynn, Pres.

San Francisco, Cal.—Bids will be received by the California Debris Comn., Flood Bldg., Feb. 17, for embankment near Daguerre Point, Yuba River, Cal., as avertised in The Engineering Record.

Sacramento, Cal.—Governor Pardee on Jan. 13 approved the appropriation of $12,000 for putting 3 jetties in Sacramento River just above where the levee broke at the Edwards place last year.

Marysville, Cal.—See "Power Plants, Gas and Electricity."

San Francisco, Cal.—Bids are wanted Feb. 16 for replanking and repairing wharf at Presidio of San Francisco, including cluster, spring and fender piles. Wm. S. Patten, A. Q. M. G., Ch. Q. M.

**Pueblo, Colo.*—The Bd. of Park Com., Park Dist. No. 2, awarded the contract on Jan. 10 for grading and seeding about 40 acres in City Park to G. Fleischer, for $9,760. Contract includes maintenance until Oct. 15, 1905.

Washington, D. C.—Bids will be received Feb. 21 at the Bureau Supplies and Accounts, Navy Dept., Washington, for furnishing at navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of machine tools, including Futtock bevel band saw machine, steel plate gate shear, drill press, crank shaper, screw cutting lathe, etc. H. T. B. Harris, Paymaster-Gen., U. S. N.

**Jacksonville, Fla.*—The Marine Eng. & Machine Co., of New York, N. Y., has secured the contract for an elevator for the U. S. Post Office, for $1,325.

Council Bluffs, Ia.—S. E. Etnyre, City Engr., is reported to have completed plans for dredging Indian Creek from 8th St. to 16th Ave.; he estimates the cost at $24,000. The various railroad companies whose bridges cross Indian Creek will be asked to aid in paying for this work.

Burlington, Ia.—C. R. Fickes, Drainage Engr., writes that the County Comrs. will soon take action on the matter of constructing the proposed drainage system. The plans include about 7 miles of levee, 16 miles of canals and 3 pumping stations. A large part of the work will have to be done by dredges, as the ground is wet. M. P. Snarts, Co. Aud.

Topeka, Kan.—Bids are wanted Mar. 6 for $80,000 general improvement bonds. J. H. Squires, City Clk.

New Orleans, La.—Bids will be received by Capt. J. F. Indoe, Corps Engrs., U. S. A., on Feb. 18 for dredging a channel near the west shore of Sabine Lake, and for constructing creosoted wooden revetment, as advertised in The Engineering Record.

*Fred Camors is stated to have secured the contract for building the new Adams Ave. levee along the new Basin Canal; 10,000 cu. yds., at 35 cts. per cu. yd.

Bids will be received Feb. 7 by the Bd. Comrs. Port of New Orleans, Room 601, Hibernia Bank & Trust Bldg., for constructing Erato St. wharf; material to be furnished by the Bd. J. F. Coleman, Engr., Room 920 Hibernia Bank & Trust Bldg.

*A. B. Davis, Asst. Engr., Orleans Levee Dist., Masonic Temple, writes that the contract for raising and enlarging the canal side of the West End R. R. embankment in 2d Dist., 10,000 cu. yds. (bids opened Jan. 18), has been awarded to Fred. Camors & Co., 505-509 Tchoupitoulas St., at 35 cts. per cu. yd.

Vidalia, La.—See "Power Plants, Gas and Electricity."

Ft. Andrews, Peddocks Island, Mass.—Bids are wanted Feb. 17 for furnishing material and constructing a drainage system at this post. Maj. John E. Baxter, Q. M., U. S. A. Room 410, 170 Summer St., Boston.

Boston, Mass.—Bids will be received Jan. 31 by the Street Dept., for furnishing beach gravel from Feb. 1, 1905 to Feb. 1, 1906. Jas. Donovan, Supt.

St. Louis, Mo.—The work of dredging the River Des Peres will be delayed about a year owing to the fact that the city does not own the right of way. F. W. Valliant, Sewer Comr.

Nebraska City, Neb.—Press reports state that Engineer A. M. Munn, of Nebraska City, will make surveys and superintend the construction of drainage ditches from near McPaul and Percival to empty into Missouri River opposite this city; probable cost of work, $40,000. Contracts will probably be let on Mar. 6.

New York, N. Y.—Bids will be received Feb. 1 by Maurice Featherson, Comr. of Docks, for furnishing material, preparing and building 2 piers and appurtenances, one at E. 102d St., the other at E. 108th St., Harlem River.

Bids will be received Feb. 2 by Maurice Featherson, Comr. of Docks, for furnishing material for preparing, extending and repairing pier at E. 37th St., East River; also for preparing and constructing a pier with appurtenances at E. 109th St., Harlem River.

**Columbus, O.*—Julian Griggs, Ch. Engr. Bd. Pub. Service, writes that D. E. Sullivan & Son, of Columbus, have secured the contract for furnishing, laying and ballasting railroad tracks adjacent to Scioto River, about 11,000 lin. ft. (bids opened Jan. 18), at $23,919 for stone ballast, $25,379 for gravel ballast, or $19,379 for cinder ballast.

Cincinnati, O.—Bids will be received by Lieut.-Col. Ernest H. Ruffner, Corps Engrs., U. S. A., Cincinnati, on Feb. 25 for building Lock No. 1 on Tug Fork of Big Sandy River; also on same date for building Lock No. 1 on Levisa Fork of Big Sandy River, both advertised in The Engineering Record.

Bids will be received Feb. 18 by the Bd. Co. Comrs., for drain pipe, concrete and fill on State Road in Crosby Township; also on same date for crushed stone on Spring Grove Ave. in Mill Creek Township. Eugene L. Lewis, Co. Aud.

Pittsburg, Pa.—Press reports state that the House Com. on Rivers and Harbors at Washington, D. C., on Jan. 17 provided for the reconstruction of Lock No. 5 on Monongahela River and the completion of the Herrs Island dam on the Allegheny, at a cost of $589,000 and $148,000 respectively.

Newport, R. I.—Bids will be received by Lieut.-Col. J. H. Willard, Corps Engrs., U. S. A., Newport, on Feb. 23 for furnishing and delivering Portland cement, broken stone, screenings and sand at Boston Neck and Ft. Adams, R. I., as advertised in The Engineering Record.

Vancouver, Wash.—Press reports state that the Portland Consolidated Ry. Co. (F. I. Fuller, Gen. Mgr., Mohawk Bldg., Portland, Ore.) will, during the coming year, build a new pontoon and a dock on the Vancouver side of the river. The company also intends building a new steel trestle on the Oregon side, at a cost of $100,000.

**Casper, Wyo.*—A. P. Davis, Asst. Ch. Engr., U. S. Reclamation Service, Washington, D. C., writes that the bid of Kirkpatrick Bros. & Collins Contr. Co., Beatrice, Neb., for the construction of the Pathfinder Tunnel, North Platte project, Neb., at $34,292, has been recommended for acceptance (bids opened Jan. 9). For detail bids received for this work, see issue of The Engineering Record, Jan. 21.

Toronto, Ont.—Park Comr. Chambers and City Engr. Rust are stated to have been instructed by the Island Com. to report on the question of establishing a city park at Hanlan's Point, immediately south of the Toronto Ferry Co.'s property.

City Engr. Rust and Comr. Fleming are stated to have submitted plans for the Island regatta course. The plans submitted provide for a course 8,000 ft. in length, commencing at St. Andrew's Ave. and running northeasterly to Ward's Island. The cost would be approximately $40,000, while the 2 or 3 bridges required will cost $10,000 more.

Toronto, Ont.—It is stated that bids will be received Feb. 7 by Thomas Urquhart (Mayor), Chmn. Bd. Control, for constructing a hydraulic dredge.

PROPOSALS OPEN.

For proposals see pages 24, 25, 26, 29.

WATER WORKS.

Bids Close.		See Eng. Record.
Feb. 1.	Ione, Ore.	Jan. 28
Feb. 1.	Mains, Brooklyn, N. Y.	Jan. 21
Feb. 1.	Hydrants, etc., Brooklyn, N.Y.	Jan. 14
Feb. 1.	**Princeton, Ky.**	**Dec. 10**
Feb. 1.	**Pipe, San Francisco, Cal**	**Dec. 3**
Feb. 2.	Machinery, etc., Philadelphia, Pa., Adv. Jan. 21, 28.	Jan. 21
Feb. 6.	Pump, etc., Jacksonville, Fla.	Jan. 14
Feb. 7.	Ellisville, Miss.	Jan. 21
Feb. 7.	Christman, Ill., Adv. Jan. 21	Jan. 14
Feb. 8.	Pipe, South Bend, Ind	Jan. 14
Feb. 9.	Ft. Keogh, Mont.	Jan. 21
Feb. 10.	**Bishop, Cal.** Adv. Dec. 10 to 24.	**Dec. 10**
Feb. 11.	Main, Norwood, O.	—Jan. 21
Feb. 13.	Boiler, Asbury Park, N. J. Adv. Jan. 28.	Jan. 28
Feb. 18.	Boilers, etc., Norwood, O	Jan. 28
Feb. 22.	Schoharie, N.Y., Adv. Jan. 28.	Jan. 28
Feb. 23.	Tilamook, Ore.	Jan. 14
Mar. 1.	Charton, Ia.	Jan. 28
Mar.31.	Meters, Pocatello, Idaho. Adv. Jan. 28.	Jan. 28
Mar. —.	Smith's Grove, Ky	Jan. 7
Apr. 1.	**Irrig., Usk, Wash**	**Dec. 24**
———	Pipe, Auburn, Me.	Jan. 14

SEWERAGE AND SEWAGE DISPOSAL.

Jan. 30.	St. Paul, Minn.	Jan. 28
Jan. 30.	Providence, R. I.	Jan. 28
Jan. 30.	Washington, D. C. Adv. Jan. 14.	Jan. 14
Feb. 1.	Palatka, Fla. Adv. Jan. 14 to 28.	Jan. 14
Feb. 1.	Cresco, Ia.	Dec. 31
Feb. 2.	St. Paul, Minn.	Jan.. 28
Feb. 3.	St. Bernard, O.	Jan. 21
Feb. 4.	Fort. Michie, N. Y.	Jan. 14
Feb. 6.	Topeka, Kan.	Jan. 28
Feb. 6.	Washington, D. C. Adv. Jan. 14.	Jan. 14
Feb. 7.	**Los Angeles, Cal.**	**Jan. 7**
Feb. 10.	**Bishop, Cal.** Adv. Dec. 10 to 24.	**Dec. 10**
Feb. 14	Bogota, N. J.	Jan. 28
Feb. 15.	Havana, Ill. Adv. Jan. 14 to 28.	Jan. 14
Feb. 15.	Linenburg, N. S.	Jan. 14
Feb. 16.	St. Bernard, O.	Jan. 21
Feb. 23.	New Rochelle, N. Y	Jan. 28

BRIDGES.

Jan. 24.	Boston, Mass.	Jan. 21
Jan. 31.	Des Moines, Ia.	Jan. 21
Feb. 2.	Helena, Mont.	Jan. 21
Feb. 4.	Holton, Kan.	Jan. 28
Feb. 6.	Minneapolis, Minn.	Jan. 28
Feb. 6.	North Platte, Neb.	Jan. 28
Feb. 6.	Topeka, Kan.	Jan. 14
Feb. 6.	Santa Barbara, Cal.	Jan. 7
Feb. 7.	Indianapolis, Ind.	Jan. 21
Feb. 7.	Binghamton, N. Y.	Jan. 21
Feb. 7.	Stockton, Cal.	Jan. 21
Feb. 7.	Muscatine, Ia.	Jan. 14
Feb. 7.	Wabash, Ind.	Jan. 14
Feb. 8.	Patchogue, L. I., N. Y.	Jan. 28
Feb. 8.	Vincennes, Ind.	Jan. 21
Feb. 9.	New York, N. Y.	Jan. 28
Feb. 12.	Indianapolis, Ind.	Jan. 28
Feb. 13.	Sherbrooke, N. D.	Jan. 21
Feb. 14.	**Napa, Cal.**	**Dec. 31**
Feb. 16.	Columbus, O.	Jan. 21
Feb. 16.	Charleston, W. Va. Adv. Jan. 21.	Jan. 21
Peb. 17.	Port Clinton, O.	Jan. 21
Feb. 18.	Cincinnati, O.	Jan. 28
Feb. 20.	Culpepper, Va. Adv. Jan. 28.	Jan. 28
Feb. 20.	York, Neb.	Jan. 28
Mar. 1.	South Bend, Ind.	Jan. 28

PAVING AND ROADMAKING.

Jan. 30.	Jersey City, N. J.	Jan. 28
Jan. 31.	**Ebensburg, Pa.**	**Jan. 7**
Feb. 1.	Buffalo, N. Y.	Jan. 21
Feb. 1.	Cleveland, O.	Jan. 21
Feb. 1.	Brooklyn, N. Y.	Jan. 21
Feb. 1.	Cincinnati, O.	Jan. 14
Feb. 2.	Repaving Sts., St. Paul, Minn.	Jan. 28
Feb. 2.	Paving Bridge, St. Paul, Minn.	Jan. 28
Feb. 2.	Cincinnati, O.	Jan. 14
Feb. 4.	Sharon, Conn.	Jan. 21
Feb. 4.	Bay City, Mich.	Jan. 21
Feb. 6.	Albany, N. Y.	Jan. 28
Feb. 6.	Worcester, Mass.	Jan. 28
Feb. 6.	Bedford, Ind.	Jan. 28
Feb. 6.	Topeka, Kan.	Jan. 14
Feb. 6.	Webb City, Mo., Adv. Jan. 7.	Jan. 7
Feb. 7.	New York, N. Y.	Jan. 28
Feb. 7.	Broad Ripple, Ind.	Jan. 21
Feb. 7.	Franklin, Ind.	Jan. 21
Feb. 7.	**Rensselaer, Ind.**	**Dec. 31**
Feb. 8.	Cleveland, O.	Jan. 28
Feb. 9.	Port Townsend, Wash.	Jan. 21
Feb. 10.	Indianapolis, Ind.	Jan. 28
Feb. 13.	Jacksonville, Fla.	Jan. 28
Feb. 14.	**Napa, Cal.**	**Dec. 31**
Feb. 15.	Cornwall, Conn.	Jan. 28
Feb. 15.	Leesville, La.	Jan. 28
Feb. 15.	Madison, Wis.	Jan. 21
Feb. 18.	Washington, D. C. Adv. Jan. 21.	Jan. 21
Mar. 1.	Grass Valley, Cal.	Jan. 28

POWER, GAS AND ELECTRICITY.

Jan. 30.	Rochester, N. Y.	Jan. 28
Jan. 31.	Mt. Union, Pa.	Jan. 28
Jan. 31.	Plattsburg Barracks, N. Y.	Jan. 28
Jan. 31.	**Ft. Walla Walla, Wash.**	**Jan. 7**
Feb. 1.	Ann Arbor, Mich.	Jan. 21
Feb. 2.	Lakewood, O.	Jan. 14
Feb. 2.	Columbus, Ind.	Jan. 14
Feb. 3.	Atlantic City, N. J. Adv. Jan. 21 and 28.	Jan. 21
Feb. 6.	Howard, Pa.	Jan. 28
Feb. 7.	Trenton, N. J.	Jan. 28
Feb. 7.	Ft. Des Moines, Ia.	Jan. 28
Feb. 10.	Ft. Leavenworth, Kan.	Jan. 28
Feb. 14.	Eureka, Cal.	Jan. 28
Feb. 15.	West Point, N. Y. Adv. Jan. 28.	Jan. 28
Feb. 15.	Governor's Island, N. Y.	Jan. 28
———.	Laconia, N. H., Adv. Jan. 28.	Jan. 28
Feb. 15.	Cleveland, O.	Jan. 21
Feb. 15.	Temple, Tex.	Jan. 21
Feb. 15.	**Chicago, Ill.**	**Dec. 24**
Apr. —.	Ft. Valley, Ga.	Jan. 21

BUILDINGS.

Jan. 30.	School, New York, N. Y.	Jan. 21
Jan. 30.	School, Brooklyn, N. Y.	Jan. 21
Jan. 31.	Bus. Bldg., Fall River, Mass.	Jan. 21
Jan. 31.	Flat, Bayonne, N. J.	Jan. 14
Jan. 31.	**Pub. Bldg., Ft. Moultrie, S. C.**	**Jan. 7**
Jan. 31.	**P. O. Bldg., Albert Lea, Minn.**	**Dec. 10**
Jan. —.	**Public Bldg., Des Moines, Ia.**	**Dec. 3**
Feb. 1.	Church, Centerville, Ia.	Jan. 28
Feb. 1.	Church, Fredericksburg, Tex.	Jan. 28
Feb. 1.	School, Oakland, Cal.	Jan. 21
Feb. 1.	Asylum, Knoxville, Ia.	Jan. 21
Feb. 1.	Church, Montezuma, O.	Jan. 14
Feb. 1.	Arsenal and armory, Hartford, Conn., Adv. Jan. 21	Jan. 14
Feb. 1.	**P. O. Bldg., Ogden, Utah** Adv. Dec. 31.	**Dec. 31**
Feb. 1.	**Church, Zanesville, O.**	**Dec. 31**
Feb. 1.	**Court House, Goshen, Ind.**	**Dec. 31**
Feb. 1.	**Court House, Elkhart, Ind.**	**Dec. 3**
Feb. 2.	Bus. Bldg., Philadelphia, Pa.	Jan. 28
Feb. 2.	Htg. Alms House, Lockport, N. Y.	Jan. 21
Feb. 2.	Htg. P.O. Bldg., Atlantic City, N. J., Adv. Jan. 14, 21	Jan. 14
Feb. 4.	Excav. for Pub. Bldg., Washington, D. C., Adv. Jan. 28.	Jan. 28
Feb. 4.	Church, Philadelphia, Pa.	Jan. 21
Feb. 4.	Coal testing plant, Roselyn, Va.	Jan. 21
Feb. 4.	School, Canandaigua, N. Y.	Jan. 14
Feb. 6.	School, Westfield, Wis.	Jan. 28
Feb. 6.	Schools, New Brighton, S. I., N. Y.	Jan. 28
Feb. 6.	School, Shreveport, La.	Jan. 21
Feb. 6.	Court House, Ocala, Fla.	Jan. 14
Feb. 6.	Htg. Post Bldg., Ft. Mott, N. J., Adv. Jan. 14 to 28.	Jan. 14
Feb. 7.	Court House, Hillsboro, N. D.	Jan. 21
Feb. 7.	Armory, Flushing, N. Y. Adv. Jan. 21 and 28.	Jan. 21
Feb. 7.	School, Philadelphia, Pa.	Jan. 21
Feb. 7.	Court House, Monticello, Miss.	Jan. 21
Feb. 7.	School, Lac du Flambeau, Wis.	Jan. 14
Feb. 7.	**P. O. Bldg., Nevada, Mo.**	**Dec. 31**
Feb. 8.	School, Baltimore, Md.	Jan. 28
Feb. 8.	School, Valdosta, Ga.	Jan. 28
Feb. 8.	Pub. Bldg., Ft. Slocum, N. Y.	Jan. 28
Feb. 8.	Masonic Temple, Watertown, Wis.	Jan. 21
Feb. 8.	School, Bolivar, N. Y.	Jan. 1
Feb. 8.	School, Halstad, Minn.	Jan. 1
Feb. 9.	Jail, New Albany, Miss.	Jan. 2
Feb. 9.	Post Bldg., Plattsburg Barracks, N. Y. Adv. Jan. 14 to 28.	Jan. 1
Feb. 9.	Post Bldg., Tompkinsville, S. I., N. Y., Adv. Jan. 14, 21	Jan. 1
Feb. 9.	P. O. Bldg., Natchez, Miss. Adv. Jan. 7 and 14.	Jan.
Feb. 10.	School, Springfield, Mass.	Jan. 2
Feb. 10.	School, Alva, Okla. Ter.	Jan. 2
Feb. 10.	School, Helena, Okla. Ter.	Jan. 2
Feb. 10.	Post Bldg., Ft. Howard, Md.	Jan. 2
Feb. 11.	Post Bldg., Chickamauga Park, Ga., Adv. Jan. 21, 28	Jan. 1
Feb. 13.	Post Bldgs., Point Bonita, Cal. Pa., Adv. Jan. 21, 28.	Jan. 2
Feb. 13.	Court House, Carlton, Minn.	Jan. 2
Feb. 14.	School, Orange, N. J.	Jan. 2
Feb. 14.	Armory, Binghamton, N. Y. Adv. Jan. 21 and 28.	Jan. 2
Feb. 14.	Htg. P. O. Bldg., Batesville, Ark., Adv. Jan. 14, 21	Jan. 1
Feb. 15.	School, Staunton, Va.	Jan. 28
Feb. 15.	Memorial Bldg., Cincinnati, O.	Jan. 28
Feb. 15.	Post Bldg., Ft. Wright, Wash.	Jan. 21
Feb. 15.	School, Talklai, Ariz.	Jan. 21
Feb. 15.	Church, Flandreau, S. D.	Jan. 21
Feb. 15.	Htg. P. O., Chillicothe, O.	Jan. 14
Feb. 21.	Htg. Guard House, Ft. Assinniboine, Mont.	Jan. 28
Feb. 21.	Univ. Bldg., Washington, D.C.	Jan. 21
Feb. 21.	**P. O. Bldg., Westchester, Pa** Adv. Dec. 31 to Jan. 7.	**Dec. 31**
Feb. 23.	Sashes, etc., War College, Washington, D. C., Adv. Jan. 28	Jan. 28
Feb. 23.	Court House, Ellsworth, Wis.	Jan. 28
Feb. 23.	P. O. Bldg., Decatur, Ill. Adv. Jan. 14, 21.	Jan. 14
Feb. 27.	P. O. Bldg., Columbia, Mo.	Jan. 21
Feb. 28.	P. O. Bldg., Louisiana, Mo.	Jan. 21
Feb. —.	**Hospital, Albany, N. Y.**	**Dec. 24**
Mar. 2.	P. O. Bldg., Adrian, Mich.	Jan. 28
Mar. 6.	Court House, Greenwood, Miss.	Jan. 28
Mar. 6.	P. O. Bldg., Battle Creek, Mich., Adv. Jan. 21, 28.	Jan. 21
Mar. 6.	Court House, Sardis, Miss.	Dec. 17
Mar. 7.	P. O. Bldg., Findlay, O. Adv. Jan. 21, 28.	Jan. 21
Mar. 8.	P. O. Bldg., Muskegon, Mich.	Jan. 28
Mar.13.	P. O. Bldg., Hammond, Ind. Adv. Jan. 28.	Jan. 28
Mar.14.	P. O. Bldg., Moberly, Mo. Adv. Jan. 28.	Jan. 28
Mar.—.	School, Klamath Falls, Ore.	Jan. 28
Apr. 5.	**Court House plans, New Orleans, La.**	**Dec. 3**

MISCELLANEOUS.

Jan. 30.	Garb. Disp., Meriden, Conn.	Jan. 28
Jan. 31.	Beach Gravel, Boston, Mass.	Jan. 28
Jan. 31.	Jetty, Portland, Ore.	Jan. 7
Feb. 1.	Levee work, Red Fork, Ark.	Jan. 28
Feb. 1.	Piers, New York, N. Y.	Jan. 28
Feb. 1.	Stripping, St. Clair, Pa. Adv. Jan. 14 to 28.	Jan. 14
Feb. 1.	**R. R. work, Sonoma, Cal.**	**Dec. 24**
Feb. 2.	Piers, New York, N. Y.	Jan. 28
Feb. 3.	Piles, San Francisco, Cal. Adv. Jan. 14 to 28.	Jan. 14
Feb. 3.	**Dredging, Savannah, Ga.** Adv. Jan. 7 to 28.	**Jan. 7**
Feb. 4.	Elevator, Nashville, Tenn.	Jan. 21
Feb. 4.	Industrial Plant, Philadelphia, Pa.	Jan. 7
Feb. 4.	**Dredging, Chicago, Ill.** Adv. Jan. 7 to 28.	**Jan. 7**
Feb. 6.	Garb. Disp., Albany, N. Y.	Jan. 28
Feb. 6.	Retaining wall, etc., Omaha, Neb.	Jan. 21
Feb. 6.	El. Ry. franchise, Los Angeles, Cal.	Jan. 21
Feb. 7.	Wharf, New Orleans, La.	Jan. 28
Feb. 7.	Hydraulic Dredge, Toronto, Ont.	Jan. 28
Feb. 7.	Supplies, Washington, D. C.	Jan. 21
Feb. 7.	Tools, Machry, etc., Panama. Adv. Jan. 14 to 28.	Jan. 21
Feb. 7.	Supplies, Philadelphia, Pa.	Jan. 14
Feb. 7.	Wharf, Ft. Totten, Willets Point, N. Y. Adv. Jan. 14 to 28.	Jan. 14
Feb. 7.	Bldg. supplies, Chicago, Ill.	Jan. 14
Feb. 8.	**Dam, etc., Phoenix, Ariz.** Adv. Dec. 3 to 24.	**Dec. 3**
Feb. 11.	Canal work, Cleveland, O. Adv., 14 to 28.	Jan. 21
Feb. 11.	Tile work, Pana, Ill.	Jan. 21
Feb. 11.	Electric Elevator, Portsmouth N. H.	Jan. 21
Feb. 11.	Crane runways, Boston, Mass.	Jan. 21
Feb. 11.	Supplies, Washington, D. C.	Jan. 21
Feb. 13.	Garbage, Atlantic City, N. J.	Jan. 28
Feb. 15.	Steam pump, Ft. McKinley Me. Adv. Jan. 21 and 28.	Jan. 21
Feb. 15.	Dredging, Chicago, Ill. Adv. Jan. 21 and 28.	Jan. 21
Mar. 15.	**Dam, etc., Los Angeles, Cal.** Adv. Jan. 21 and 28.	**Jan. 14**
Feb. 16.	Wharf, San Francisco, Cal.	Jan. 28
Feb. 16.	Garbage, Chicago, Ill. Adv. Jan. 21, 28.	Jan. 21
Feb. 16.	Dredging, Detroit, Mich. Adv. Jan. 14 to 28.	Jan. 21
Feb. 17.	Drainage, Ft. Andrews, Peddocks Island, Mass.	Jan. 28
Feb. 17.	Emb'kmt work, San Francisco, Cal., Adv. Jan. 28.	Jan. 28
Feb. 18.	Channel work, etc., New Orleans, La., Adv. Jan. 28.	Jan. 28
Feb. 18.	Crushed stone, Cincinnati, O.	Jan. 28
Feb. 18.	Drain Pipe, Cincinnati, O.	Jan. 28
Feb. 20.	Garb. Disp., Waterbury, Conn.	Jan. 28
Feb. 21.	Machine tools, Washington, D. C.	Jan. 28
Feb. 21.	Cement, Fernbank, O. Adv. Jan. 21 and 28.	Jan. 21
Feb. 23.	Cement, etc., Newport, R. I.	Jan. 28
Feb. 23.	El. Ry. franchise, San Diego, Cal.	Jan. 21
Feb. 25.	Lock work, Cincinnati, O. (2 Prop.) (Adv. Jan. 28)	Jan. 28
Feb. 27.	El. Ry. franchise, Stockton, Cal	Jan. 28
Mar. 6.	Drainage work, Nebraska City, Neb.	Jan. 28
Mar. 17.	Dredge, etc., St. Louis, Mo. Adv. Jan. 21 and 28.	Jan. 21
Mar. 31.	**El. Ry., Shanghai, China**	**Oct, 22**

**Items marked thus give the names of parties awarded contracts.*